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FIELD MUSEUM

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COLOMBO, CEYLON.

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Photo by
H. F. Macmillan.

PETRÆA VOLUBILIS.

(*See p. 34.*)

THE

TROPICAL AGRICULTURIST

AND

MAGAZINE OF THE

CEYLON AGRICULTURAL SOCIETY.

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Reviews.

TACKY RUBBER.

[Ueber einige einleitende Versuche zur Klärung der Ursache des Leimigwerdens von Rohgummi. Von. Dr. D. Spence (Universität Liverpool). Sonder-abdruck aus Zeitschrift für Chemie und Industrie der Kolloide, Bd. IV., Heft 2 und 3.]

The author has for some months been engaged in the study of the causes of tackiness in rubber, and has issued a preliminary account of some of his experiments. He refers rather caustically to the various theories which have been propounded in explanation of this phenomenon, *e.g.*, oxidation, putrefaction, the action of Bacteria, and Enzymes, and points out that none of these is based on any scientific experiment. He agrees with Professor Bertrand, who read a paper on the subject at the Rubber Exhibition of 1908, that Bacteria cannot be the direct cause of tackiness. Unfortunately, the Report of these lectures is not yet available.

"Thanks to the experimental researches of Bertrand, we have no longer much to fear from Bacteria with regard to tackiness. To pacify those who still pin their faith to the theory of the bacterial origin of tackiness, it may be pointed out that it remains to be proved whether bacteria have not perhaps an indirect influence, in so far that they may possibly create a suitable medium in which tackiness can afterwards occur. I refer here especially to the formation of acid substances through the action of bacteria on the protein substances and their constituent carbohydrates in raw rubber. To me it is quite unthinkable that bacteria can have any direct action upon the actual caoutchouc, but it is however imaginable that they might exert a small indirect influence in giving rise to conditions which favour tackiness. This possibility appears to have been hitherto totally overlooked, and I bring it forward since it indicates the need of further investigations into the action of bacteria—not on caoutchouc but—in caoutchouc."

"For the benefit of those who, in spite of the lack of logical experimental evidence, believe in the enzyme theory of tackiness, I may point out that I have taken the trouble to prepare a large number of rubbers from latices which were freed from enzymes as far as possible, and that, even in those preparations to which I had given the greatest conceivable care in the removal of the enzyme before coagulation, I have several times observed exceptionally well-developed tackiness. Consequently the enzyme is not directly concerned in the production of tackiness, though naturally here again the possibility of an indirect action because of the presence of the enzyme in the rubber must be taken into consideration. It can be

imagined that in some cases the enzyme favours the subsequent occurrence of tackiness by setting up such conditions as facilitate the initiation of the changes which heat and sunlight afterwards accelerate."

The author proceeds to describe an experiment in the coagulation of *Funtumia* latex which had been preserved in a liquid state by means of ammonia. The ammonia and salts were separated by dialysis, and the latex was then sterilised. Part of the sterilised latex was coagulated by means of decinormal sulphuric acid, while the other was treated with sterilised water only. Absolute alcohol was then added to both, and they were heated to 100°C to obtain complete coagulation in both cases. The rubber obtained by water and alcohol only was a white elastic mass with very good tenacity and with "nerve," while the rubber coagulated with sulphuric acid was very soft and plastic without either tenacity or "nerve." After the samples had been washed and dried, the former was a sample of good rubber, while the latter melted into a soft resinlike paste. Thus from the same sample of latex, two entirely different specimens of rubber were obtained, one sound and the other excessively "tacky."

The dry weight of the samples proved that no "Oxidation" had taken place, and acetone extraction showed that the percentage of resin was practically the same in both, while further analysis proved that the tackiness was not due to chemical changes. These facts, together with experiments on the viscosity, etc., lead the author to the conclusion that tackiness depends not on chemical changes but on physical changes. Sunlight and heat appear to be the most efficacious agents in its production, but it may also be produced by dilute sulphuric acid.

The result detailed above is of extreme interest to rubber planters at the present time, since it indicates that the same latex, coagulated by different methods, may produce rubbers varying enormously in strength. For several years it has been an article of faith that rubber from young trees is weaker than that from older trees. Certainly the available samples of rubber demonstrated this, and it will require strictly controlled, logical, scientific experiment to upset this belief, though, from a botanical standpoint, it must be confessed that there is no valid explanation why rubber from young trees should be weaker. The oft-quoted statements about the greater amounts of resin present in young rubber do not agree with the recorded analyses. But one flaw in the argument which supports the current belief may be pointed out, though the possible error may not be so important as it appears. The comparisons between rubber from old and young trees have been made on samples from different estates, possibly coagulated by different methods or by unavoidable variations of the same method. Seeing that different methods of coagulation may produce such strikingly different results, it is evident that, from a scientific standpoint, the question of the strength of the rubber from trees of different ages must be regarded as more or less an open one, until samples have been prepared by the same method and by the same operator.

Practical observations on tackiness are all, at present, more or less vague. It is confidently asserted that tackiness is communicable, *i.e.*, that a tacky biscuit infects others in contact with it, but the possibility that, in the supposed instances of this, similar external or internal conditions may have produced tackiness in these biscuits successively is overlooked. It is not sufficient to put a tacky biscuit on the top of an apparently sound one, and then to argue that the "disease" has been transferred when the lower biscuit becomes tacky.

I have been informed by one planter that he can induce tackiness in crepe rubber at will, by including in it scrap rubber which has been allowed to remain on the tree for several days.

At present no experimental evidence can be offered, but the following instances may be recorded, since they show the improbability that tackiness is due to bacteria or fungi. In November, 1907, some biscuits were made from latex from the old Hevea trees at Henaratgoda, and were left lying in the laboratory at Peradeniya. Some of these were by accident placed on a table where the sunlight fell on them, and these subsequently became tacky. One of these tacky biscuits has been lying on the top of a sound biscuit for over six months, but the lower biscuit has not become tacky. Again, in March, 1908, a sample of crepe (Hevea) which showed pale yellow spots, the first stages of tackiness, was sent in for examination. A piece with a large yellow spot was selected, and, after the yellow area had been accurately marked out, the piece was covered with a bell glass, and left lying exposed to light (not to direct sunlight) on the table. The yellow area subsequently became semi-fluid, but this condition has not spread in the slightest

degree up to the present time, and the transference of this semi-fluid rubber to sound parts of the same piece has no set up tackiness at the spots to whic it was applied. Further, tackiness affects vulcanised rubber as well as raw rubber, though the causes may be different. In 1906, some small glass pipettes, such as are used for filling fountain pens, were bought from England for use in the laboratory. They were furnished with red vulcanised rubber teats. Six of these were wrapped up in paper and put away in stock, while one, which was used occasionally, was kept in a drawer on a cardboard tray. The teats of the six in paper were found to be tacky and in parts semi-liquid in March, 1909, while that in the drawer (usually in darkness) had flowed for a length of four centimetres along the glass tube and over the cardboard. But another similar pipette, with a black teat, has been kept in a drawer for more than four years, with occasional use, and the teat is still sound.

T. PETCH.

GUMS, RESINS, SAPS AND EXUDATIONS.

BOTANICAL FACTS FOR RUBBER PLANTERS.

By R. H. LOCK.

Recent discussions in the local press on the best methods of tapping Para rubber have revealed so many remarkable misunderstandings of the actual way in which a rubber tree grows and gets its living, that it appears as if the following facts, although describing matters which are doubtless familiar to many planters, may yet be of some service to those who are not equipped with a knowledge of botany. We shall endeavour in what follows to avoid technical terms as far as possible, and to describe the few simple facts which it behoves anyone who has charge of a rubber plantation to understand, in language which can be grasped without any previous scientific training whatever.

The organs or parts of a plant may be divided into two chief kinds: on the one hand those which are concerned with growth and feeding, namely, the leaves, roots and stem, and on the other hand those which are concerned with reproduction, namely, the flowers and seeds. For the present we shall disregard all questions concerning the seed and younger stages of the plant, and, imagining our rubber tree to be already well established and grown to some considerable size, we shall consider the growing parts of the tree and how they are likely to be affected by the operation of tapping.

As already remarked, the growing organs of the tree consist of leaves, stem and roots. The function of the roots—to take the last-mentioned organs first, is firstly to hold the tree firmly upright by anchoring it in the soil; and, secondly, to absorb certain substances contained in the soil which are essential for the nourishment of the tree. Among the most important of these substances, as is well known to all who are familiar with the application of artifical manures, are certain compounds of nitrogen, phosphorus and potash.

Before these materials can be made use of as food by the different parts of the plant, it is necessary for them to be altered and combined with the still more important substance carbon, which is obtained only by the leaves, one of whose functions is to absorb this substance from the air in the form of carbonic acid gas. We may compare the leaves of the tree to so many minute kitchens in which the different ingredients of the tree's food are prepared and compounded into a form in which they can be utilized by the roots, stem and other organs.

We now pass to the functions of the stem or trunk of the tree. The first of these is to support the leaves in a position where they are well exposed to air and sunshine, and the second is to conduct the necessary mineral substances from the roots to the leaves, and also to conduct the elaborated food supply downwards from the leaves to the roots.

The trunk of a tree is well known to consist of two main portions—the wood and the bark. If the bark is stripped from the wood the separation takes place at an extremely soft and delicate layer of tissue known as the cambium. Channels for the conduction of sap occur both in the wood and in the bark, and two entirely different streams of sap are associated with these two regions. An upward current of sap occurs in the outer part of the wood, by means of which current the mineral substances absorbed by the roots are carried to the leaves in a state of very weak solution.

The perfected food materials are carried down through definite channels in the inner part of the bark by a stream of sap which is entirely independent of the upward stream. The system of minute vessels which contain the latex or rubber milk are entirely separate from both the above mentioned sets of channels, and have nothing to do with either of them. The upward and downward streams of sap are found in all trees, but latex occurs only in a few.

The evil results of ringing the bark, or severing it by a cut which penetrates to the cambium and extends right round the tree, are primarily due to the interruption of the downward food supply which must ultimately lead to the starvation of the roots and the consequent death of the tree. Such ringing may occur more or less completely as the result of injudicious tapping. Any cut or prick which reaches the cambium must sever a certain number of the channels through which the sap passes down to the roots, and it is highly probable that the weakening effect of excessive tapping is quite as much due to the starvation of the roots as to the removal of the latex. Any system of tapping which involves the cutting or pricking of the whole circumference of the tree at one time is especially bad from this point of view, and it must be considered advisable never to tap more than a third, or at the most one-half, of the total circumference of the tree at any one time.

After a certain interval tapping may extend to the untapped portion of the circumference. This is owing to the strong recuperative powers of the bark or rather of the cambium. This important layer consists of a very delicate tissue in which growth and the formation of new and more permanent tissues are constantly going forward. On the outer side of the cambium, and consequently on the inner side of the bark, new additions are constantly being made to the bark itself to replace what is removed by ordinary wear and tear or by the tapping knife. These additions include both new channels for the descent of sap and new vessels for the storage of latex, the two systems being, as we have already pointed out, entirely independent of one another.

The latex tubes being entirely separate from the vessels in which the food bearing sap is transported, the question naturally arises what is their use to the tree? and what is the precise function of the milky emulsion of rubber which they contain. This is a point as to which we are still very much in the dark, From the fact that the great majority of trees get on perfectly well without any latex at all, we are driven to the conclusion that this substance is not absolutely essential to the life of the plant, and it is certainly the case that large quantities of latex can be removed without causing any visible injury to the health of the tree. On the other hand, the latex is undoubtedly formed at the expense of valuable food material, and the removal of latex must thus indirectly cause a drain upon the supply of food available for the roots and for the purposes of general growth. This drain is additional to that check to the food current which is caused by the partial ringing effect which even the best tapping produces. The amount of tapping which can be safely carried out is therefore limited, though only experience can decide the point at which safety ends and danger begins.

Even the most expert tapping is therefore dangerous if carried to excess. Inexpert tapping is attended with another and more serious danger in the injury to the cambium which it involves. The cambium is such an important part of the tree that it is very desirable for the planter to have a definite idea as to its nature and functions. Situated as it is between the wood and the bark, the cambium is the seat of growth of both these regions. Injury to the cambium involves the cessation of growth at the spot where the injury occurs, and since only the younger portion of both wood bark are active in the upward and downward sap-transport already described, any extensive injury to the cambium involves serious damage to the whole economy of the tree, quite apart from the danger that the germs of disease may make their entry at the point of weakness.

Owing to the extreme thinness of the cambium itself, injuries to this tissue involve corresponding damage to the outer part of the wood and to the inner part of the bark. Taking first the case of the wood, if the injury to the cambium is not extensive, a renewal of growth soon takes place and the injured wood becomes buried beneath fresh layers of woody tissue. By cutting into the outer part of the wood the traces of old injuries can often be found. Injuries to the inner part of the bark caused by irregular tapping are often of a more serious nature, especially when fragments of the outer bark or other foreign substances are driven in to the neighbourhood of the cambium through injudicious pricking. In this case

there often arises an abnormal growth of woody nodules in the bark itself, as has been fully described by Mr. Petch in a recent circular (Vol. IV., No. 18). These nodules lead to serious difficulties in the tapping of the renewed bark. Mr. Petch associates this form of injury especially with the use of the blunt pricker, although we are assured that this instrument has frequently been used without the production of any of these nodules. The precise effect no doubt depends to a considerable extent upon the individuality and vigour of particular groups of trees. At the present time we do not consider that the problem of what is the best possible method of tapping is by any means settled, and whilst recommending that every new method should receive a thorough and extensive trial, we are inclined on purely theoretical grounds to adopt a somewhat conservative attitude, believing that the greatest safety lies in careful paring by the herring-bone or half-herring-bone method. In operating this method not more than a third of the circumference of the tree should be attacked at any one time.

RUBBER CULTURE IN CEYLON.

(From the *Gardeners' Chronicle*, XLV., 1, 151, January, 1909.)

Attention was drawn in our issue of October 3rd last, to the developments which have taken place during recent years in the cultivation of rubber plants. It was pointed out how largely these developments have been due to the activities of the Government Botanic Departments in various parts of the world. Although the cultivation of Rubber is being prosecuted with zeal in the tropical possessions of other nations, it is gratifying to be able to record that the pioneer work was carried on within the British Empire. The first important step was the introduction to Ceylon and elsewhere of the supplies collected by Mr. H. A. Wickham in the Amazon Valley and brought to Kew under circumstances of considerable difficulty. The expense of Mr. Wickham's expedition was borne by the Government of India, but, as Ceylon seemed to offer more suitable conditions, the young plants were despatched thither, and later this colony acted as the distributing centre for other British possessions. The staff of the Ceylon Botanic Gardens, moreover, carried out experimental work and made discoveries which were, in a large measure, instrumental in securing for rubber cultivation the position of a profitable industry.

The world's annual output of rubber is now about 69,000 tons, of which amount tropical America contributes some 64 per cent., tropical Africa 34 per cent., and tropical Asia the remaining 2 per cent. The tropical American yield is credited in the main to three plants, *Hevea brasiliensis* (Para rubber), *Manihot Glaziovii* (Ceara rubber), and *Castilloa* elastica (Central American rubber). Other species of Hevea and various species of the allied genus Sapium probably also contribute to the output of "Para rubber." More than one species of rubber-producing Castilloa have also been recognised, and recent observations point to there being other useful species of Manihot besides *M. Galziovii*. The three plants mentioned may, however, be regarded as being the main source of American rubber. They have all been introduced into Ceylon, and we may consider separately their histories in the colony.

Of *Hevea brasiliensis*, a supply of some 2,000 young plants was received in Ceylon in 1876, transmitted from Kew in thirty-nine Wardian cases. These plants had been raised from the seed collected by Mr. Wickham in the Amazon Valley. A special garden was prepared for their reception at Henaratgoda in the low, moist country, and some were also planted at Peradeniya, about 1,500 feet elevation. The plants succeeded very well. Henaratgoda soon supplied plants to widely distant parts of the tropics, at first from cuttings and later from seed. As the plants became old enough to yield rubber—usually about their sixth year—experimental tappings were commenced. To this end V-shaped incisions were made in the bark of the young trees, and the exuding latex collected in cups of coconut shell placed at the base of each trunk. In this manner the late Dr. Trimen, F.R.S., the then Director of the Gardens, obtained from one tree, during six years, by tapping made in 1888, 1890, 1892, and 1894, a yield of over 10½ lbs. of good dry rubber. A definite step forward resulted from the experimental work of Dr. J. C. Willis, the present Director of the Ceylon Botanical Gardens, and Mr. J. C. Parkin, who carried out the investigations from 1897 onwards. They discovered the existence of the phenomenon known as "wound response." It was found that if a definite region of the bark was tapped several times at short intervals the yield of rubber increased considerably at each tapping. Many methods of the coagulation of the latex were also tried, resulting in the preparation of the now familiar thin "biscuits." The net result was to

show that Para rubber cultivation in Ceylon might be looked upon as a reasonably profitable industry. Planting made such rapid strides that, at the present time, there are in the colony some 180,000 acres under rubber crops. Definite evidence of the progress of the industry is afforded by the increase in amount and value of the exports of rubber from Ceylon during the past seven years, Whereas, in 1900, the quantity of rubber exported from the colony was but 8,223 lbs. of £859 in value, by 1908 it had increased to upwards of three-quarters of a million pounds, and was valued at £195,475.

It was thought at first that Para rubber would not succeed in Ceylon at elevations greater than about 500 feet, but the tree has since proved to do well at heights even exceeding 2,000, and probably 3,000 feet should be regarded as the limiting altitude in the colony. The tree will grow at much higher elevations, but would not be likely to prove profitable.

The history of Hevea cultivation in Ceylon affords an excellent example of the usefulness of Botanic Gardens equipped with proper facilities for the carrying out of experimental work. If the Ceylon Gardens had done nothing else during their history than established this industry, they would have more than justified their existence. But, in addition, they were, as is well-known, the means of introducting coffee, tea, and cinchona, to take only the more striking instances, all of which plants have played important parts in the economic history of Ceylon.

Ceara rubber (*Manihot Glaziovii*), another South American tree, was introduced into Ceylon by Kew in 1877, the supplies of seeds and plants having been obtained by Mr. Cross. By 1883 as many as 977 acres were reported as being under this plant. The yield of rubber, however, was very disappointing, and, with the rapid development of the tea industry about this period, the cultivation of the Ceara-rubber tree fell into neglect. The Para rubber tree afterwards gave more promising results and interest was transferred to it. Recently, however, it has been shown that rubber of very high value can be prepared in Ceylon from the Manihot, and it is not improbable that, in the future, it will be grown in places too high or too arid for the Para rubber tree but well suited to the more drought-loving Ceara plant.

Central American rubber (*Castilloa elastica*), known to the Spaniards as the Ulé, was introduced into Ceylon with the Para rubber plants in 1876. It was grown like the Para rubber at Peradeniya and Henaratgoda. Trees are now distributed about the Island, but they have not been cultivated in an extensive scale, and comparatively little is known as to the yields obtainable from this species in the island, although experimental tappings have yielded rubber of high value.

Amongst other rubber trees introduced into Ceylon are the Assam rubber tree (*Ficus elastica*), the familiar India-Rubber plant of this country. The avenue of this handsome tree leading into the Peradeniya Gardens is well-known to visitors to Ceylon, the curious buttress-roots being very characteristic. No serious use has ever been made in the island of *Ficus elastica* as a rubber-producing tree.

From Africa there have also been introduced the Lagos silk rubber tree (*Funtumia elastica*), which has not proved successful owing to the young plants being very liable to defoliation by the attacks of a caterpillar, and the various rubber vines (*Landolphia spp.*) which, from their climbing habit, are not well adapted for estate cultivation.

RUBBER PROSPECTS IN BRAZIL.

(From the *Tropical Life*, Vol. V., No. 4, April, 1906.)

One of the leading South American houses interested in rubber sent us the following letter under date February 2nd :—"We should be much obliged if you would kindly let us know if there is any literature existing relating to the prospects of the natural rubber produced in South America, in view of the increased cultivation in the East. A client of ours in South America, who is much interested in the development of the rubber industry, has asked us for information on this point, and as it opens up a somewhat complicated problem, we think it probable that the question has been dealt with." In answer to this we sent some articles on the subject, including a copy of Tropical Life for March last, with our leading article on "The Fall in the Price of Hard Para," together with the following letter : "In answer to yours of February 2nd, the only trustworthy matter printed *re* the prospects of rubber will be found in current tropical literature. In face of the present prices being paid for rubber, one can only feel that, for the present at any rate, the demand exceeds the supply, although at the moment trade is not good, at least it is

said not to be, and motor-cars, champagne, &c., are stated to be in less demand.

"I therefore feel that we can take to-day's trade as a good average, and this at present brings in too high a price for rubber to put tyres and floorings on a popular basis. I agree with those who maintain that when Para rubber comes permanently to 2s. 6d. per lb., so many uses will be made of it, that all the areas under cultivation even then will be well employed to supply the demand.

"Of the Eastern centres, I would fear Ceylon the least; it deserves all it can get, but its soil tends to be worked out. Malaya, with its virgin soil and large uncultivated tracts, is more dangerous, but lacks labour. Brazil's most dangerous rival in the future will be Java, with its teeming industrious population, who are just the class to work rubber, as it is not an exacting crop, and enables the Javanese to go home and plant and gather in their rice. If, in face of all this, Brazil ever allows herself to be cut out by the East it will be entirely her own fault, for she has the cards in her hand. We understand that besides cultivating the areas already worked, Brazil has still vast areas untouched.

"Let the States, therefore, really federate and co-operate together, and not put on vexatious inter-State restrictions and taxes. Put motor-boats on the rivers, and encourage men capable of developing her cultivated rubber and other resources without destroying them to go up into the interior to bring down the rubber, paying a royalty on the same to one centre only, not a tax to each State that they have to pass through. If Brazil does this she would attract outside labour and capital to develop her dormant riches."

RAPHIA WAX.

(From the *Bulletin of the Imperial Institute*, Vol. VI., No. 4, 1908.)

In a communication made to the Paris Academy of Sciences in December, 1905, Professor M. H. Jumelle of Marseilles drew attention to a vegetable wax, prepared by the natives in certain districts of Madagascar, from the leaves of the raphia palm (*Raphia Ruffia*), well known as the source of the "bass" used by gardeners for attaching plants to stakes. A fuller account of the preparation of this material was given in the *Bulletin Economique de Madagascar* (1906, 6. 48). As it appeared, from the first accounts published, that this product might be of some economic value, the Director of the Imperial Institute applied to H.M. Consul at Tamatave for samples of the wax, and these were supplied early in 1907. The wax has now been examined, and submitted for technical trial to manufacturers. As the results of this work present many points of interest, it has been thought desirable to give a short account of it in the *Bulletin*.

Raphia bass consists of the epidermal portion of the upper side of the leaf of the raphia palm. When the leaf opens out, the two surfaces which have been in contact in the young stage form the upper surface of the leaf. This has a glossy epidermis, which, on being stripped off, forms the raphia bass. It is on the dull under surface of the leaf that the wax occurs as a whitish layer or bloom, readily detachable by rubbing lightly with the finger.

It is from the residues of the leaves left after the extraction of the bass, that the wax has, up to the present, been obtained. These residues, called by the natives "Taimbontgona," are available in large quantities in the neighbourhood of the raphia groves which have been worked for bass. They are spread out to dry on cloths in the open air, sheltered from the wind, as even a slight breeze is sufficient to blow away much of the light waxy matter. The drying usually takes from two to four days, and at the end of that time a white pellicle is apparent on the under surfaces of the leaves. It is then only necessary to shake the leaves or to rub them between the hands to cause the waxy matter to detach itself, mostly in the form of powder or fine dust. The powder is collected, sifted from foreign material, and placed in boiling water, when the wax melts and floats to the surface, whilst any earthy impurity settles to the bottom. The liquefied wax is then transferred to a receiver, where it is allowed to cool and solidify. The product thus prepared is yellow to dark brown in colour, rather harder and more brittle than beeswax.

The following quantities are given as the yields of bass and wax in an experimental extraction of these products in Madagascar. The experiment was made on ten raphia palm leaves of medium size ($3\frac{1}{2}$ to $4\frac{1}{2}$ metres in length):—

	Kilos.
Total weight of leaves ...	104·5
Weight of dry bass obtained	4·6
Weight of dry residue (less the ribs of leaves)	11·0
Weight of wax after preparation	0·78

In this experiment the yield of wax was equal to 0·75 per cent. of the weight

of leaves used, and to about 17 per cent. of the weight of dry fibre extracted. In practice, however, it would be lower, and possibly equal to about 10 per cent. of the weight of fibre.

Examination of the Wax.

Professor Jumelle showed that in many respects this product resembles the carnauba wax of commerce, obtained from *Copernica cerifera.* It has approximately the same melting-point (83° C.), and behaves in the same way towards various solvents. Raphia wax has been subjected to a more detailed examination by Prof. Haller and M. Descude. The results of these investigations indicate that although in physical properties raphia wax resembles carnauba wax to some extent, the two differ considerably in composition.

Two samples of the raphia wax were received at the Imperial Institute. The first consisted of a solid cake weighing 330 grams.

It was yellowish brown in colour, for the most part, but greyish at the edges, and was sufficiently brittle to powder in a mortar.

The second sample was larger, and consisted of two cakes weighing together eight pounds. The lower part of one of these cakes contained a large quantity of sandy or gritty impurity due to careless preparation. Only the upper portion of this was taken for chemical examination.

The results are given in the following table, which also includes, for the purpose of comparison, the corresponding values for carnauba wax and beeswax.

	Raphia wax. 1	Raphia wax. 2	Carnauba wax.	Bees wax.
Specific gravity at $\frac{99^{\circ}C.}{15{\cdot}5^{\circ}C.}$	0·836	0·832	0·842	0 820
Acid value	49·	6·5	3·4-7·0	19-21
Saponification value ..	51·3	50.3	79-84	90-99
Iodine value ...	7·68	10.7	13·5	8-11
Melting-point of wax ..	82°C.	83°C.	83°-86°C.	63°-65°C

Results of Technical Trials.

The results of the comparative examination showed that the raphia wax agreed closely in physical characters with carnauba wax, and it was considered likely that it might be used for the same purposes, such as the manufacture of polishes, candles, etc.

A firm of boot-polish manufacturers, who were consulted on this point, were at first inclined to view the product favourably, and asked for a larger sample for trial. Unfortunately the second large sample received at the Imperial Institute, as indicated above, contained a good deal of gritty impurity, and this the manufacturers reported rendered the material unsuitable for their purpose.

A firm of candle and soap manufacturers who were also consulted, reported that in some respects the material possessed the qualities of certain waxes already on the market, and although they took exception to the inherent "oiliness" and the dark colour of the wax, they expressed their willingness to purchase a small consignment at the rate of £40 per ton, for trial on a large scale. Inquiries made by H.M. Consul at Tamatave as to the possibility of obtaining commercial supplies of the wax, indicate that a price of £40 per ton would not cover the cost of collecting, preparing and shipping the wax, and that the latter cannot be produced at present for less than £80 per metric ton f.o.b. Tamatave.

As the present price of carnauba wax ranges from £4 10s. to £7 per cwt., it is possible that if raphia wax of good quality, pale colour, and free from grit could be shipped in quantity at £80 per ton, it might find considerable use as a substitute for carnauba wax.

DYES AND TANS.

TANNING MATERIALS.

(From the *Report on the Work of the Imperial Institute, 1906-1907*, No. 584.)

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Transvaal ..	1	Gambia ..	1	Gold Coast ..	1
Uganda ...	2	Sierra Leone	1	Foreign Countries ..	3
Somaliland ..	3	Gold Coast ..	1		
Sudan ..	1	Transvaal ...	1		
Seychelles ..	1	Cape Colony	10		
India ..	14	Uganda ..	3		
Western Australia ..	3	Sudan ...	2		
		Seychelles .	12		
British Guiana ...	1	British Honduras ..	4		
		Bazil ...	1		
Total ..	26	Total ..	36	Total ...	4

1906.—None of the samples of tanning materials examined proved to be sufficiently rich in tanning to be worth consideration for export to the United Kingdom, but most of them were of fair quality and suitable for local use in tanning. This is the case, for example, with the three interesting materials from Somaliland, viz., "Wattu" leaves derived from *Osyris abyssinica*, a near relative of the plant which yields the so-called "Cape Sumach," "gallol root bark," from a species of Acacia near *Acacia latronum*, and "maua bark," of unknown botanical origin. These yielded respectively 24·8, 24·0 and 13·7 per cent. of tannin. The two first-mentioned furnished leathers of medium quality, whilst that prepared with maua bark was of fair quality, but rather harsh and somewhat dark coloured.

The samples from India were extracts prepared from the barks of *Shorea robusta*, *Terminalia tomentosa* and *Rhizophora mucronata*. Of these the most promising were those prepared from the lastnamed bark. They contained high percentages of tanning, but were rather dark coloured, indicating the need for greater care in evaporating the liquors prepared as a first step in the manufacture of the extracts.

1907.—The samples from Cape Colony included six samples of wattle bark derived from the golden wattle, *Acacia pycnantha*, and the black wattle, *Acacia decurrens*. All these proved to be of good quality and similar in type to the wattle barks now imported from Natal and Australia. They were valued from £7 10s. 0d. to £7 15s. 0d. per ton.

The other samples from Cape Colony were samples of barks from indigenous trees, "White thorn" (*Acacia horrida*), "Krupeehout," "Kliphout," and of Cape Sumach. These were all of poorer quality than the wattle barks, and most of them though suitable for local use were of no value for export.

The samples from Uganda included "Busana bark," derived from a species of Acacia, probably *Acacia spirocarpa*. This is being used in the neighbourhood of Entebbe as a tanning material. It contains about 10 per cent. of tannin and yields a rather harsh, dark-coloured leather, and should only be used in admixture with the better materials imported to Uganda from India. A sample of the bark of *Terminalia velutina* was also received from Uganda. This contained 12 per cent. of tannin and yielded a light-coloured leather of fair quality.

The Sudan materials were samples of Kili bark from *ficus sp.* and "Alimu" bark from *Ximenia americana*. The latter proved to be of fair quality for local use.

The samples from Gambia, Sierra Leone, Gold Coast Colony, Seychelles and British Honduras were all mangrove barks. Of these samples certain of those from Seychelles alone yield sufficient tannin (*i.e.*, over 40 per cent.) to be worth consideration for export. The other samples could only be used locally for tanning or for the manufacture of tanning extracts. The samples from British Honduras and the Gambia, however, included barks which were of special interest on account of the unusually good and light-coloured leather they produced for mangrove barks. The examination of this large collection of mangrove barks has enabled some useful information to be obtained regarding the value of scraping off the outer bark before shipment, and it seems certain that in most cases the outer bark contains little or no tannin, and its removal before export raises the average tannin content of the bark and reduces the bulk.

The sample from Brazil was "barbatimao bark" sent by the British Consul at Rio de Janeiro with a view to ascertaining whether this material, largely used in Brazil for tanning, is of commercial value. The sample proved

to contain 27·8 per cent. of tannin and to yield a leather of very good quality. It is worth noting that this tree has been introduced recently into German East Africa with a view to the utilisation of its bark for tanning purposes.

At the end of the year a sample of divi-divi pods from the Gold Coast and samples of mangrove bark from Portuguese East Africa were still under investigation.

ANNATTO.

(From the *Agricultural Journal of India*, Vol. IV., Part I, January, 1909.)

Annatto is employed as a dye for calico, silk, wool, skins, feathers, ivory and bone and in colouring butter and cheese. It produces a fast colour of both yellow and red tints. The plant (*Bixa orellana*) is a native of West Indies and other parts of tropical America.

It is a shrub or small tree of very branching habit of growth and attains a height of 8 to 12 feet. It is a hardy plant and fruits very freely in the plains of India in any ordinary soil and climate.

The fruit is a capsule which, when ripe, splits into two valves, on the inside of which are attached seeds covered with a thin coating of reddish waxy pulp. This waxy substance contains the colouring matter known as Annatto.

The dye is extensively used for colouring butter and cheese in nearly all countries, for which purpose in India the seeds are ground to a fine powder and soaked in pure olive, sessamum or safflower oil. The extract is then strained through fine muslins.

The plant is propagated from seed which should be sown in a shaded nursery. When the seedlings are about four months old, at which time they should be 6 to 8 inches high, they should be transplanted about 12 feet apart, if the soil is good. Pits should be dug out to a depth and diameter of 18 inches for each seedling.

Fair crops may be expected in three or four years, but it takes longer to get a fully established plantation.

In India the plant has been grown chiefly in Government gardens. It is a plant of considerable economic value and should be more widely cultivated.

The seeds, when ripe, should be extracted from the capsules and dried in the sun. They may then be steeped in very hot water. By stirring, the waxy testa is then washed off from each seed. After some days the whole mass should be strained. The liquid should be allowed to ferment for a week and then the dye matter settles. The clear water should then be poured off, and the dye dried in shallow pans. When the substance is semi-hard, it may be moulded into rolls, wrapped in banana leaves, and then becomes the ordinary Annatto of commerce.

In Jamaica, Annatto is an important export, almost entirely produced by the peasant class. These exports are increasing and go chiefly to the United States.

FIBRES.

NEW FIBRES FOR PAPER.—III. FIBROUS ANNUALS.

BY WILLIAM RAITT, BANGALORE.

Although bamboo is likely to take the leading position among new sources of paper-making material, it by no means exhausts the possibilities of our tropical and sub-tropical forests, which teem with fibre-yielding plants of every order and variety. The difficulty is not to find them, but to make a selection of those likely to prove profitable in use. It is not necessary here to enter into details of the methods used, and principles underlying the process of elimination of the unfit. Suffice it to say that out of the many hundreds of fibre-yielding species, only those of the order *Gramineæ* are suitable for modern paper-making, and of these comparatively few fulfil all the necessary requirements. It is desirable to be explicit on this point, in order to avoid the disappointment which is certain to result from attempts to exploit plants, merely because they have been proved to contain fibre.

It is, above all things, essential that the plant is in sufficient abundance, in any given locality, and sufficiently gregarious in habit, to bring the cost of collection down to a minimum. The importance of this will be fully realised, when it is remembered that all costs

incurred in handling the raw material must be multiplied by 2½ or 3, in order to arrive at the cost on the finished product, since the yield of cellulose will rarely exceed 40 %, and may be as low as 30 % of the dry weight of the plant. Then, the quantity available, at or near the proposed factory site, must be sufficient to produce a paying output. This is an item which will vary considerably in accordance with other manufacturing facilities available, but as a minimum I would be inclined to insist on an annual crop of 7,500 tons, dry weight, within economic range of the factory. In the case of bamboo, the amount should be at least 10,000 tons. The question of what constitutes a profitable yield of cellulose also largely depends upon local conditions. Where the manufacturing and export facilities are exceptionally favourable, a raw material giving 30 % may prove a paying proposition. Under other circumstances 40 % may be necessary. Generally speaking, nothing under 30 % is worth considering.

Most of the fibrous annuals can be successfully treated by the alkaline method of reduction, and in this respect they have an advantage over more highly lignified materials like bamboo, which require acid treatment. The capital cost of buildings and machinery is considerably less, and need not be on so large a scale in order to get on to a paying basis. On the other hand, the working cost per ton of pulp is greater, but this again is compensated for by the product being of a better quality and worth a higher price.

It is impossible to deal at length with all the fibrous grasses known, but as types of the classes most worthy of attention we may refer to three species which have already proved of value for paper-making.

Muriz (*Saccharum Sara*)—a reed-like grass found on *chur* and waste lands in Northern India. Very gregarious in habit, growing in dense thicket-like masses, which can be cut and collected at low cost. Being generally found in the neighbourhood of rivers, the economic radius of collection is widened by the possibilities of water transport. Yields an excellent, easily bleached pulp, similar to that of wheat straw.

Bhabar or Sabai (*Ischœmum augustifolium*)—a grass of the bent or rye-grass type, growing extensively on the Central Indian tableland, in tussocks, and fairly gregarious. Produces a pulp similar to that of esparto. Is the leading staple of the Calcutta paper mills. Economic radius of collection limited by the hilly nature of its habitat, and the cost of cart and rail transport. In certain localities this could largely be eliminated by pulp mills erected in the centres of producing districts.

Eta (*Beesha Travancorica*)—a reed allied to bamboo—common on the Tinnevelly and Travancore hills. Although found only at high elevations, (3,000 ft. and over) it is so densely gregarious and luxuriant in growth, that its low cost of cutting and collection compensates for transport charges out of the hills, and in several localities water carriage is available. One of the most promising sources of paper-making material.

Wild grasses, similar to those in nature and habit, are to be found scattered all over South Eastern Asia. Provided that they contain at least 30 % of cellulose, their value as paper-making material depends entirely on the manufacturing facilities associated with their locality of growth. The proper surveying, testing and valuation of these scarcely falls within the scope of the non-expert observer, but certain broad principles may be laid down for his guidance, which will at least prevent him going to any expense over propositions which the expert would at once condemn as hopeless. These will be briefly indicated in the fourth and concluding article of this series.

Before leaving this branch of the subject, a word may be said about rice straw. Usually the cultivated straws are worth more for other purposes, and it may be accepted as an axiom that the paper-maker can only use that which has no value for any other purpose. Rice straw has a considerable paper-making value, and in districts where it is grown in quantities largely in excess of local requirements for fodder and other uses, and where suitable manufacturing facilities exist, there are good grounds for enquiry into the possibilities of a straw-pulp industry. It yields a pulp of high quality, and for which there is a good demand. Textile wastes lie outside the scope of these articles, but I may be excused for referring to one of them, in order to announce a development which may be of considerable interest to the cotton grower, and especially to the decorticator and presser of the seeds. The fine down adhering to the decorticated husks, though of high value as a paper material, has hitherto been impossible to work, owing to the difficulty of separating it from the husks. This difficulty has now been overcome. By a simple and inexpensive process, the down can be isolated and made use of for the highest grades of paper.

The ordinary waste of cotton factories and gins has too much dirt, foreign matter and particles of husk associated with it to be of much value for pulp-making; but where a local demand exists for brown, grey and casing papers, it may be profitably transformed into these. Spinning mills are themselves considerable users of casing and packing papers, and groups of these would find it advantageous to have a paper mill in their midst to use up their waste and supply them with the product therefrom.

BRITISH COTTON GROWING ASSOCIATION.

FOURTH ANNUAL REPORT.

(From the *British Cotton Growing Association's 4th Annual Report,* December, 1908.)

In presenting their fourth Annual Report of the work carried on by the Association since Incorporation, the Council regret that, owing to the serious drought which occurred throughout the whole of West Africa in 1907, they have to record the first serious important check which has as yet been experienced. On the other hand, great progress has been made in other parts of the Empire, and more especially in Uganda. It may be mentioned that in West Africa droughts, such as occurred last year, while not unprecedented are of rare occurrence, and over thirty years have elapsed since the last serious failure of rains.

The Council again record their thanks to His Majesty's Government for the great assistance rendered in many directions, and also to the officials of the various Government Departments both at home and in the Colonies, who have taken an active part in forwarding the objects of the Association. The Conferences at the Colonial Office have been continued under the chairmanship of Colonel Seely, D.S.O., M.P., the Under-Secretary of State for the Colonies.

The Council regret to record the death of their esteemed colleagues, Mr. Henry Higson and Mr. Herbert Milne.

During 1908 the Council have met on fourteen occasions, and there have been seventy-six meetings of Committees and Sub-Committees.

On March 20th, 1908, a Banquet was held, the principal guest being the Right Hon. Winston S. Churchill, M.P., the then Under-Secretary of State for the Colonies. The President (Sir Alfred L. Jones, K.C.M.G.,) again most generously defrayed the expenses of the guests. A presentation of a silver dessert service was made to Mr. Churchill by some members of the Council on the occasion of his wedding in recognition of the invaluable services rendered by him to the promotion of the Cotton Growing Industry in the British Empire.

In May the Annual International Cotton Congress was held in Paris. The late Mr. Henry Higson read a paper on the work of the Association.

A Conference was held in July in Manchester and Liverpool with representatives of the West Indian Cotton Growing Industry, which is expected to have most valuable results. The proceedings have been previously very fully reported and circulated in pamphlet form, but the Council wish again to record their thanks to Colonel Seely for his attendance at the Conference at considerable personal inconvenience. Thanks are also due to the Lord Mayors of Manchester and Liverpool, to the Mayor of Oldham, and to the Chairman and Directors of the Fine Cotton Spinners and Doublers Association who most kindly assisted in the entertainment of the guests. Sir Alfred Jones also entertained the delegates at luncheon on behalf of the Association both in Manchester and Liverpool. The hotel expenses were defrayed by the Members of the Executive Committee. Thanks are also due to Sir Alfred Jones and to Mr. Owen Philipps, M.P., who made arrangements for conveying the delegates to England at reduced fares on the steamers of the Imperial Direct West Indian Mail Co., and the Royal Mail Steam Packet Co. The Directors of the Manchester Ship Canal Company and the Mersey Dock and Harbour Board also most kindly placed steamers at the disposal of the delegates to enable them to inspect the Liverpool and Manchester Docks.

The thanks of the Association are also due to Mr. Reynolds, the President of the Liverpool Cotton Association, who has taken the greatest interest in the development of British grown cotton, and to whom is due the recent action of the above Association in standardising the various grades of the West African cotton.

The arrangements entered into with the British Cotton Ginning Company, Ltd., have now been completed. Of the subscribed capital of £100,000, £72,930 has been paid up, and £65,344 has been handed over to the Association in payment for buildings and machinery transferred to the Company. The sum of £5,870 has been paid in interest and expenses, and a further sum of £9,059 has

been paid by the Association towards the sinking fund for the ultimate repayment of the Company's capital. This latter amount is invested in first-class securities as shown in the Balance Sheet, and the interest therefrom will be paid to the Association.

As stated in the last Report, the Council did not feel justified in continuing the expenditure on canvassing. The total amount of shares subscribed for on December 31st, 1908, amounted to £261,195. Although the financial resources of the Association are sufficient for the present commitments, the Council are of opinion that additional capital will shortly be needed, more especially in view of the rapid extension of cotton growing in Uganda and of the immense field which will shortly be opened when the Northern Nigeria Railway reaches Kano.

The Council regret exceedingly that the depression in trade, following the financial crisis in the United States, has had a most serious effect on the transactions of the Association during 1908, and this was much aggravated by the dispute in the Lancashire Cotton Industry. During the latter part of the year especially, cotton was difficult to sell and could only be disposed of at low prices. It is to be feared that this may have the effect of discouraging, and will certainly check for a time the development of new cotton fields. There are, however, distinct signs of improvement in trade, and it is to be hoped that the present depressing conditions may soon disappear, and that there may shortly arise a steady demand for cotton goods and consequently for raw cotton.

The work of the Association continues to grow in every direction, and hardly a day passes without requests for advice and assistance from some part of the Empire. The following statement of the letters despatched during 1908 will convey the best idea of the almost overwhelming extent of the work:—

United Kingdom	24,783
West Indies	3,380
West Africa	1,639
East Africa	124
Nyasaland	58
South Africa	56
Australia	28
France	77
Germany	23
Sundries	91
Total	30,259

This represents an average of over 100 letters per working day, and, as a similar number of letters are received, over 200 letters have to be dealt with every day by a staff of only fifteen in number.

The engineering portion of the work has increased so largely that it has been found necessary to add a competent engineer to the Head Office Staff, and the Association are now able to give expert advice to planters and others when ordering ginning and other machinery, and to supply plans and detailed estimates. No charge is made for this beyond an agency commission of 2 per cent. on the cost of any plan ordered through the Association. Arrangements have been made for supplying planters with baling materials and other stores, which, owing to the Association's exceptional buying, can be supplied on the lowest terms. Arrangements have also been entered into for insuring cotton and seed at moderate rates, and policies can be effected whereby cotton is covered against all risks, fire and marine, from the time it is weighed in at the planter's store up to delivery at the warehouse at Liverpool. The commissions for these services and also on the sale of cotton it is hoped may eventually cover the whole cost of the administrative charges in England.

The Association have been carrying out some very important experiments with cotton seed as fuel for gas engines, and two experimental plants have been sent out, one to Lagos and the other to Mombasa. If these experiments are successful they will have most important results in Northern Nigeria, Uganda, Nyasaland, the Soudan, and other districts where the cost of coal is prohibitive and seed is at present of little or no value, as they will prove that cotton seed will be the most economical fuel for providing power, not only for ginning and baling factories, but also for other works, such as railway repairing shops, pumping stations, etc.

In view of the great difficulty of obtaining trained agricultural experts with a knowledge of cotton and other tropical products, representations have been made to the Government urging a system whereby suitably trained men should receive a further practical training in the West Indies, Ceylon, and elsewhere, and the Council are glad to report that a start has been made in this direction. The Council has urged the establishment of agricultural scholarships, and the proposal is still under consideration.

Following the resolution passed at the Conference with the delegates from the West Indies, representations have been made to the Government urging the formation of a Bureau for Tropical Agri-

culture for the collection and collation of information and the direction of agriculture in our tropical possessions. On the initiative of the Oldham Chamber of Commerce, a resolution supporting the above was unanimously approved at a meeting of the Associated Chambers of Commerce held in London in March, 1908.

The arrangement with the Government as to the grants-in-aid from the Local Governments in Africa expires on March 31st, 1910. Under this arrangement the following annual grants are made:—

Southern Nigeria	£5,000
Northern Nigeria	1,000
Gold Coast	1,500
British East Africa	1,000
Total	£8,500

By the above arrangement it is stipulated that the Association shall contribute a like amount, and that the total of £17,000 shall be annually spent in experimental and instructional work. The present state of the Association's finances will prevent the continuance of the existing arrangement, and the whole question is now under discussion with His Majesty's Government. It is hoped that some satisfactory arrangement may be come to whereby the useful work which the Association has carried on during the last seven years will be in no way curtailed, and by which the co-operation, as between the Local Administrations in the various colonies concerned and the Association, will be maintained.

REPORT OF WORK IN THE COLONIES.

INDIA AND CEYLON.

Messrs. Shaw, Wallace. & Co's experiments with "Tree" and other cottons have been continued during 1908, but the results have not been satisfactory.

Some progress has been made with the cultivation of Egyptian cotton in Sind, with the following results:—

	Acres.	Yields.
1905 ...	1,000 ...	459 bales of 400 lbs.
1906 ...	5,098 ...	700 ,, ,,
1907 ...	6,835 ...	1,835 ,, ,,
1908 ...	6,000 ...	—

It is understood that the arrangements for marketing the crop are now satisfactory, and the native growers are receiving remunerative prices for their cotton.

Some experiments are being carried on with acclimatised American seed in the Punjab. The 1907-8 crop was a failure, but the present crop is doing well, and not only are the growers obtaining higher prices than for indigenous cotton, but the yield of the American cotton is also larger.

An extension of cotton growing has also taken place in Ceylon, and the Association advanced £1,000 for the erection of a ginning plant. Unfortunately the firm to whom the machinery was sent are unable to carry on the work, and negotiations are in progress with the Ceylon Government to secure the working of the plant. A considerable amount of selected West Indian Sea Island seed has been sent out by the Association free of charge.

A grant of £10,000 was made by the Association for experimental purposes to the Indian Government in 1905, and £2,000 of this has been spent in various ways with useful results. As, however, the demand for financial assistance from other parts of the Empire were more urgent, representations were accordingly made to the Government requesting that the Association should be relieved of further liability. The Council are glad to report that the Government of India have kindly acceded to this request.

COTTON GROWING.

BY DANIEL JONES.

(From the *Queensland Agricultural Journal*, Vol. XXII., Part 3, March, 1909.)

GATHERING AND PREPARATION.

Much misapprehension exists relative to the method of picking cotton in our State.

Very much has been said of the great necessity for care in this process to avoid unduly gathering leaf and other *débris* along with the fibre; also on the need for drying and separating stained and immature fibre.

Too much emphasis has all along been laid on these precautions, resulting in valuable time being lost.

That ordinary care must be observed, in justice to the buyer, needs no reiteration, nevertheless the trader's interests, along with the producer's, are not advanced by methods which in themselves are not called for, and in the end serve to add largely to the cost of production.

For some years past it has been my object to lay before growers the importance of economically handling this crop so as better to meet local labour conditions, and generally expedite the picking operations. The cultural methods in vogue in Queensland, for the most part, call for little attention, the cotton crop requiring little, if any, more tillage or experience than what is demanded for ordinary field crops.

In the picking, however, we are lamentably lacking in that celerity common to the American cotton-grower. It will best serve my purpose to give, in as brief a manner as possible, the manner in which the farmer in the United States handles his great crop.

The American planter to-day, by reason of labour conditions, has little or no advantage over the Queensland grower. The day of abundance of negro field labour is now a matter of histroy; the negro, although once largely in evidence as a help in the cotton fields, has now, by reason of his advanced education, drifted into other, and, to him, more congenial fields of activity than that of the ordinary farm hand.

So it happens that a large percentage of American farms have no coloured or cheap labour whatever employed. Thus Queensland farmers are under no disability in the matter of low-priced labour. The secret of American superiority lies in the fact that their simple and methodical handling of the crop gives them a very material advantage.

In Queensland a picker, if, at the end of a day's toil he has gathered 100 lb. of fibre in the seed, it is regarded as a good evidence of brisk effort, while an increase of 20 to 30 lb. constitutes a record, working on Upland varieties. With the American this quantity represents a very poor day's work, three and even four times this amount being frequently gathered for periods of time.

The Washington Department of Agriculture makes the official statement "that first-class pickers can pick, by hand, an average of 500 to 600 lb. of seed cotton per day, and as much as 800 lb. occasionally. A white hand was timed in 1894, and he picked 60 lb. in an hour, or 1 lb. per minute." This, of course, is not possible unless there is a good blow of cotton out, and in the process a more than ordinary amount of leaf-trash is collected with the fibre.

As evidence in substantiation of the claim here made on behalf of the American picker, I may give my personal experience at Capella, in Central Queensland, in June last, on the farm of Mr. Willis Hargrove, an American grower recently settled in that locality, and who is chiefly engaged in this vocation, beginning in a small way with a few acres. Mr. Hargrove then had employed a young American, a Mr. Rowan, who has since gone into cotton-growing on his own account, and, at the present time, has 30 acres looking well and nearly ready for harvesting in the same district. This person elected to prove that American claims were genuine, and, in my presence, in two hours he gathered 58 lb. cotton, 27 lb. in the first hour, and 31 in the second, which, at the price of ½d. per lb. for picking (the rate allowed) shows his earnings to be a fraction under 1s. 3d. per hour. It may be said this was an exceptional spurt, but as it was done in but a half-crop of cotton, it is easy to realise that an average of 250 to 300 lb. a day would be no extraordinary result for an active experienced picker.

In handling such cotton as Sea Island, Egyptian, Mascotte, or Caravonica varieties, equally good results will not be attained, by reason of the character of the cotton bolls, which are not free in parting with the fibre, and not as large in pod.

The person here referred to claimed to have picked, in the States, 500 lb. a day on many occasions. To enable this to be done, very expert handling must be acquired, especially the ability to gather equally as well with the left as with the right hand, using both simultaneously. This training is acquired by degrees, and it is always impressed on the young picker that both hands must be trained to acquire the ability to pull the fibre with equal facility. This once mastered, solves the problem of economically and profitably handling a large cotton crop, without which the Americans would often lose a large portion of their annual 14,000,000-bale harvest, and ensures for the pickers, even at a much lower scale of payment than our growers are satisfied to pay, a fair remuneration for his service.

To enable the picker to best carry on his work without impediment, the Americans use a different picking bag to ours, being in every way much easier on the pickers. It is made of strong calico, and is about 7 or 8 ft. long, with shoulder straps made so as to allow the bag to swing on the left side, and, for the most part, trailing on the ground behind the picker. This bag is thus constructed to permit the free use of both hands, and avoid loading the picker with the weight of fibre gathered which lies in the bag trailing behind him. This bag when full is emptied on a sheet placed in a

convenient position in the field, and is usually all the drying the cotton gets. Of course, no cotton is gathered under wet weather conditions. Should rain take place before the cotton is placed under cover, then a further drying process is imperative.

It must be expected that cotton so rapidly picked is not as free from leaf and dirt as in the case of the slower process ; nevertheles, the American buyer is content to have his article in this form, and no diminution of value ensues as the result of a little foreign matter in the fibre, which is practically unavoidable under the circumstances.

In Queensland we have erred too much in our method of picking and drying of this crop. My remarks here refer only to the Upland and low-priced fibres. Such high-quality cotton as Sea Island must have very much more care taken in its picking and preparation for market. Upland cotton then is easy to gather, particularly if the pickers do not enter the field to look for cotton. Too often our growers start their hands into the field, and, after rambling about all over the rows, they have little to show for their time. This practice is often indulged in by those unfamiliar with the pursuit, who have lent the ear to needless warnings of danger from over-exposure to weather, wet or dry.

My local experience is that the weather rarely injures a cotton crop when fit for gathering. Cotton, if well opened, will stand heavy rain with little injury. It is when the pods are partly opened, and lodgement is found for the wet, that the greater damage is inflicted. However, this is a misfortune not often experienced here, the reverse being too often the case, since the absence of rain is a more dreaded feature of agrarian interests than surplus moisture, which may, in any serious degree, menace a cotton crop.

Stained cotton also is sometimes referred to as an undesirable feature of the crop, and too much has been said about the liability of the Queensland crop to this risk. Rarely, if ever, does the cotton come to hand in commercial quantities where this objection can be raised. Cotton which is stained is seldom gathered, nor does it pay the picker to trouble with any cotton but the clean, ripe, and well-opened. Stained cotton, unless the discolouration be due to the depredations of beetles, is rarely seen in Queensland, is usually due to weather or boll worm attack, and, so far, in very limited quantity, hence it is never considered profitable to bother with any fibre but that which is of first quality. This simplifies and accelerates very much the operation of gathering. Last season's cotton was gathered in satisfactory condition after three months' exposure to the weather, no reduction in value being enforced on the grower. This disproves the idea expressed by those unacquainted with cotton that it is too tender in its nature to stand long exposure without detriment to its value. Here, with our dry warm Summer and Autumn weather, when the cotton opens out, the conditions for successful harvesting are ideal ones, no other cotton country having any conditions superior to ours in this respect, save perhaps Egypt, where rain rarely falls, and the crops cannot be produced otherwise than by an expensive system of irrigation.

In pointing out, as here stated, the most economical methods of picking cotton, it will, I trust, be understood that in no sense is it laid down that the crop can just be hustled in without any care or supervision. It is not judicious nor safe to neglect ordinary precautions in preparing the fibre in good order and condition, for this, in justice to the buyers, must be attended to. Hitherto we have undoubtedly erred on the other side, and in our extreme anxiety to have our article in top condition, we have materially and unnecessarily increased the cost of production. The American has no such scruples, and thus is enabled to handle his 200 to 300 lb. of cotton per hand with ease. Again, his field operations are also much less extended than ours, whereby he saves labour at points where our methods are superfluous.

Briefly stated, in the United States, the planter sends his hands into the field when the blow is good—no looking for fibre. The pickers gather with their usual speed, the picking bag, as heretofore described, is emptied on to a large sheet, which is about all the drying the cotton receives. This remains on the sheet until noon or till the day's work is over. The four corners of the sheet are then drawn together, and the cotton therein carried to the wagon located in the field ready for it. Often the fibre is carried direct from the pickers' bags to the wagon. It is here weighed and loaded. When the wagon is transferred and filled, the mules are hitched in, and the team pulls the vehicle to the ginnery, located in the most central position convenient to the general body of planters.

On arrival at the ginnery the load is placed on a weighbridge and recorded.

Subsequently a suction tube, operated by a fan, is lowered into the wagon and the contents are rapidly drawn into the battery of gins operating in the build-

ing. The lint and seed are separated, the seed dropping into sacks for transport, the lint falling into the hydraulic presses. Thus, scarcely a hand has touched the fibre since the picker placed the article in his bag.

This is how the up-to-date Yankee now handles his huge cotton crop and makes a living under much greater difficulties than the Queensland grower has to contend against.

American land is dearer than ours; it invariably must be fertilised with costly manures; the yield per acre does not, on the average, come up to the Queensland yield; insect troubles are greater; the quality of lint is not so good as ours.

This is admitted by the British Cotton Growers' Association, who have repeatedly stated our fibre to be worth 1d. per lb. over average American.

If our motto now is as it once was: "Advance Australia," it then becomes the duty of all to recognise the potentialities of this vocation. So far as our limited plantings have shown during the past few years, cotton has given better returns to farmers than most farm crops.

Economy in handling as here outlined will do much to popularise this pursuit if the country is to become an agricultural State.

The outlook in this direction is not too promising; with the heavy decline reported in agriculture last year, totalling, as per report of Department of Agriculture, 30,000 acres, it looks as though this State is to be noted for little else than its mineral, grazing, and dairying activities. These, in themselves, are very important, but are not the interests which best promote close and permanent settlement, just as important? A cotton planter with little capital, under ordinary conditions, can make sure of a good living on 30 acres of crop, usually returning from £6 to £9 or over per acre. He gets from one acre quite as much as a dairyman does from one cow, with much less risk and attention and deprivation of home comforts. One point I wish to emphasise is this—that the so-much-talked-of interference with the children's education as the sequence of cotton cultivation stands without point. Most farm pursuits engage the little ones, but I know none, save sugar, which offers the same opportunity of satisfying the adult in point of remuneration as this crop does.

If the American can gather—and he undoubtedly does gather—the amounts credited to him, we need no juvenile or cheap labour. An active adult trained to the work, which is quickly acquired, earning his 6s. or 7s. a day in a light, healthy, open-air pursuit, should have no ambition to seek the unhealthy, cramped occupations of the factory.

As a change of vocation for our male and female factory operatives, this work should be very popular, for not only would the earning be superior to the city vocation, but the cost of living would be much cheaper, and the work calling for little skill or strength, would be within reach of many who, under present conditions, are either or nearly on the verge of becoming unemployable.

The season's crop is now nearly ready in some districts for gathering, and it will be well for growers to study the system outlined for the cheaper handling of the crop. Farmers in dry weather can safely transfer such cotton as is free from wet or dew and fully ripe, direct from the picking bags to the bale, which will be economy in handling and economy of space and room.

THE JUTE INDUSTRY.

(From the *Indian Trade Journal*, Vol. XIII., No. 159, April 15, 1909.)

It would perhaps be difficult to discover a more striking record of industrial progress than that which is presented by the Indian Jute industry in recent years, says a writer in the *Times* Financial and Commercial Supplement. The rapidity of the progress can best be realized from a few figures which show how the business of jute manufacture has developed during the last 28 years:—

Year.	No. of Mills.	Nominal Capital £.	Employês	Looms.	Spindles.
1879-80	22	2,246,000	27,510	4,950	70,800
1889-90	26	2,600,000	59,500	7,700	156,900
1899-1900	34	3,978,000	102,400	14,100	295,300
1904-05	38	5,395,000	133,200	20,000	409,200
1906-07	44	6,330,000	166,900	25,300	520,500
1907-08	50	7,019,000	187,800	27,200	562,300

This table brings out the remarkable fact that, while the number of mills has increased by 127 per cent. and the capital by 212 per cent., the looms and spindles have increased by 450 and 694 per cent. respectively. Moreover, employment is now found for about seven times as many persons as formerly. All but three of the mills are located in Calcutta or its vicinity, and all but two are worked by joint-stock companies. It is worth noting that a considerable change has occurred in the relative amounts of sterling and rupee capital invested in the industry, the former constituting nearly two-thirds of the total of nominal capital in 1879-80 and only

two-fifths in 1907-08. If paid-up capital and debentures are taken together, the rupee investments amounted to £5,643,000 and the sterling to £3,020,000 in 1907-08.

INCREASE IN PRODUCTION.

The increase in actual production has been even greater than the growth in productive power as indicated by the number of looms and spindles, owing to the enhanced demand for jute manufactures, and possibly also to improved organisation of the industry and greater skill on the part of the workers, Thus the average annual exports of gunny bags for the quinquennium 1879-80 to 1883-84 were 54,900,000, while those of gunny cloth were 4,400,000 yards, the whole being valued at £833,000. In 1907-08 the corresponding figures were 293,000,000 bags and 790,000,000 yards of cloth of a total value of £12,199,000. So during the period the exports of gunny cloth rose from an insignificant figure to a gigantic total, and their value was greater than the value of the exports of bags. The average price of Hessian cloth (10½ oz., 40 in.) in 1907-08 was 17s. 10d. per 100 yards, as compared with 19s. 6d. in 1906-07 and 15s. 2d. in 1905-06. The rise in the value of jute manufactures is, of course, largely due to the increased value of the raw material, the output of which, though showing a considerable increase, has not risen in proportion to the demand in India and abroad.

GROWTH OF EXPORTS.

It is noteworthy that exports of raw jute have risen with the outturn of jute manufactures in India, though by no means proportionately. During the period from 1879-80 to 1883-84 the price of ordinary jute was Rs. 23½ per bale of 400 lb., and the average annual export of the fibre was 7,500,000 cwt. In 1907-08 the exports were 14,200,000 cwt., and the price was Rs. 42, as compared with Rs. 65½ in 1906-07 and Rs. 44 in 1905-6. Thus the fall in 1907-08 was greater than the rise in 1906-07. The last estimate for the season's jute crop was 6,310,800 bales, or a decline of 35 per cent. on the preceding one. The imports into Calcutta and Chittagong for the six months to December last amounted to 5,837,000 bales, while the exports amounted to 3,196,000, and the takings of the local mills to 2,391,000 bales.

The trade returns for the nine months ended December 31st last show that India's exports of raw jute and jute manufactures, as compared with the corresponding period in 1907, were as follows :—

		Raw Jute.		Bags.		Cloth.
1908 ...	Cwt.	13,562,829	No.	224,747,780	No.	610,807,253
	£	10,264,260	£	4,030,778	£	4,282,776
1907 ...	Cwt.	10,670,926	No	212.747,488	No.	632,106,238
	£	9,440,694	£	4 333,829	£	5,345,963

These figures serve to show that in spite of financial troubles and a diminished demand from certain markets the trade of the current financial year has been by no means unsatisfactory.

DRUGS AND MEDICINAL PLANTS.

DRUGS.

(Report on the Work of the Imperial Institute, 1906-1907. No. 584.)

Samples reported on during 1906.	No.	Samples reported on during 1907.	No.	Samples awaiting investigation at the end of 1907.	No.
Gold Coast ...	4	Gold Coast	3	Sierra Leone	4
Sierra Leone...	13	Northern Nigeria ..	4	Northern Nigeria ...	1
Uganda ...	1	Sudan ...	2	Lagos ...	1
Rhodesia ...	1	Nyasaland ..	1	British East Africa ...	1
Zanzibar ...	1	Natal ..	1	Somaliland ..	1
Transvaal ...	1	India ...	1	India ...	30
Sudan ...	3	S. Settlements	19	Straits Settlements	1
India ...	3	Federated Malay States...	1	New S. Wales	1
		New S. Wales	1	Foreign Countries	2
		B. Honduras	2		
		For. Countries	2		
...	27	Total ...	37	Total ...	42

A considerable number of drugs have been dealt with during the two years 1906 and 1907. In this connection it may be noted that Indian Podophyllum (*P. Emodi*) and Egyptian henbane (*Hyoscyamus muticus*), the constituents of which have been previously examined at the Imperial Institute and shown to be of medical value, are now being regularly exported for use as drugs.

The most important of these investigations conducted in the two years referred to are those carried on for the Government of India, and include the chemical examination of Indian species of Aconites, Hyoscyamus, Datura and Strychnos, and also Indian opium and opium alkaloids. Considerable progress has been made with the first four of these enquiries, which are, however, not yet completed.

The investigation of the best process of extracting the alkaloids from Indian opium is now practically complete. A

new process has been devised for the preparation of morphine and codeine from waste Indian opium at the Indian Government Factory at Gazipur. Preliminary trials of this process on a small commercial scale have been carried out, and these were so successful that plant for carrying out this process has been devised, and is now being constructed under the supervision of the Department for despatch to India.

The other samples referred to above have been mainly drugs in use by natives in the countries mentioned, and in a few cases the preliminary examination of these has shown that they are likely to be worth full investigation, and arrangements have been made for undertaking this. Passing mention may be made of drugs from the Sudan, which were specimens of the well-known drugs, senna leaves and pods. These were of fair quality.

The samples from the Straits Settlements in 1907 consisted of morphine salts, forwarded for a report on their purity and commercial value. A sample of coca leaves was received from the Federated Malay States, where the cultivation of this plant is now receiving attention. These proved to be of fair quality, and suggestions were made as to improvements in the preparation of this material for the market.

Other samples received in 1907 and worth mention were kola nuts from the Gold Coast Colony which were of saleable quality, hops from India, valued at 30*s.* per cwt. as compared with English hops selling at 40*s.* per cwt., and a number of arrow poisons from Northern Nigeria, which proved almost invariably to be species of Strophanthus.

Two so-called "soap plants" were examined, "Gusangus" root from Somaliland and "soap berries" and leaves from British Honduras; both of these contained saponin-like substances.

The products awaiting investigation at the end of 1907 were mainly native drugs of the types already alluded to. Those from India were *Hyoscyamus*, *Datura* and *Aconitum* species, the investigation of which is being continued.

TURKISH TOBACCO EXPERIMENTS IN THE CAPE COLONY.

By L. M. Stella,
Turkish Tobacco Expert.

(From the *Agricultural Journal of the Cape of Good Hope*, Vol. XXXIV., No. 4, April, 1909.)

Owing to information received by the Department of Agriculture, which indicated latent possibilities of success in the culture and curing of Turkish Tobacco in the Colony, experiments were started in 1906 on several farms lying in the western portion of the Colony and also on the Government Experiment Stations, with varying results, but on the whole with sufficient success to warrant their continuance. The area under cultivation comprised in all 7½ acres, on which 120,000 plants were grown, and as a result of which 3,000 lbs. of tobacco sold at an average price of 1s. 6d. per lb. Taking into consideration the several initial difficulties of inexperience which militated against anything like a good crop, the result though apparently small, gave promise of future success, especially as, had the seed been sown earlier, and two seasonable crops instead of one late one secured, higher returns would have been received.

Variations in the nature of the soil were also factors to be contended with; in some instances new land was used. It can now be definitely stated, as an experience of these past experiments, that the soil found most suitable for Turkish tobacco growing in the area where the experiments were conducted should be well drained, such as grey orchard land or red ground with a percentage of from 30 per cent. to 40 per cent. of clay, as far removed as possible from the locality of gardens, vineyards and orchards, preferably on the slopes of or close to mountains. Black and damp soils should be avoided, especially when stituated in flats and surrounded by trees, as the plants are liable to be affected with mildew.

Irrigation has not been found necessary in the districts where Turkish tobacco has grown up to the present, excepting when planting so as to give the plant a good start; and when well established and cultivated, plants will stand drought, in some cases better than a vineyard will.

The experiments were continued during 1907 in nine different districts, including those farms on which the former experiments were conducted, and a successful crop of 13,000 lbs. was raised

and sold at an average price of 1s. 11d. per lb. or 5d. per lb. in excess of the previous year's crop. Of these experiments failure took place in two cases, those of Riverdsale and Mossel Bay Districts. In both these places the crop at the outset grew luxuriantly, but when coming into maturity during the months of January and February, these localities were visited by heavy mists which damped the tobacco leaves and caused mildew. On this account the experiments had to be abandoned.

In addition to the foregoing, fourteen private farms were again selected for experiments during 1908, and there is now under cultivation nearly seventy acres, which, it was estimated, would yield 35,000 lbs. of tobacco, but owing to severe drought and the presence of cut worms, it is feared that this figure will not be realised. Great improvement has been made in curing, as a result of which a fairly good quality of tobacco is confidently expected.

The labour involved, while not arduous, requires some skill and, above all, constant attention to detail. In curing the services of women, girls and boys can be used with advantage, as the cost is not so great as when the ordinary labourer is employed.

The proper sorting and grading of the leaf is imperative, as a slight difference in the quality seriously affects the value, especially where moth-eaten and diseased leaves are threaded with good ones. Skilled supervision is therefore essential and in the end justifies itself by greater profit.

It is somewhat difficult to adequately describe the appearance of the leaf at its various stages, or to explain how skill in the handling of the leaf can be attained. The only practical means of instruction is by ocular demonstration, the value of which will be apparent to all, especially growers themselves.

Preparation of the Land.—In the Western Province, where the annual rainfall can be depended upon, virgin soils must be ploughed and allowed to lie at least one year before being used. In April, or after the first rain, the land must be reploughed to a depth of 8 inches. Three ploughings, which are practised in Turkey, are recommended, and the soil must be brought into a fine tilth and deeply stirred. During June the ground must be manured, and the manure ploughed in, and at the end of August it must be reploughed and harrowed, or better still, rolled.

Manuring of Land.—Thus far past experience shews that Karoo or sheep and goat manure, at the rate of 6 tons per acre, answers best, but experiments are being carried out with artificial manures, and it will be seen whether they are suitable for the purpose and which gives the best result.

Seasons.—For the past two seasons the seed was sown from the end of May to the first week in August, and it has been found that the best time for Districts such as French Hoek, Drakenstein, Paarl, Wellington, Stellenbosch, Caledon and Cape is at the beginning of July, provided the seed beds are well prepared and covered with muslin. By these means plants have been raised this season fit for transplanting within fifty-four days, whereas in some cases where the seed beds were prepared and sown at the end of May, the plants were not ready before the middle and end of September.

The Seed Beds.—The best way of making the seed bed is to select a warm, sheltered spot with soil not liable to dry out and perferably with a northerly or easterly aspect. The ground should be trenched, unless it already happens to be a piece of watered garden soil. Mark out beds 3 feet wide and any length, separated by paths a foot in width. Remove the soil to a depth of 10 inches, and lay at the bottom 4 inches of pure hot manure, which must be tramped down well, then fill in the trench with a porportion of one-third soil to two-thirds of old rotted manure, well mixed together. A very fine seed bed is then prepared with the rake, after which it must be thoroughly wetted and the seed sown on the wet ground very thinly at the rate of about one ounce to sixty square yards of seed bed. To do this, the seed is well mixed with sand or ashes, about ½ oz. of seed to a soup-plate of sand, and sown half in one direction and half in another, to secure uniform distribution. The seed is covered by riddling over it a quarter of an inch or less of sand or a mixture of old manure—sifted—and sand. To protect the plants from insect pests, weeds, etc., the proposed seed beds should be burnt by making a fire of branches or rubbish on top of them till the soil is scorched to a depth of 3 inches; the resulting ashes must be mixed with the soil previous to sowing the seed. The sprouting plants must be protected from frost and wind. This is best done by surrounding the beds with planks and covering them with muslin or butter cloth.

Treatment in Seed Beds.—The beds are kept moist until the seeds sprout, which may take from ten to fifteen days according to the weather. The beds are then watered every day, before sunrise,

with a watering can having a fine hose, held low so as not to wash the plants out of the ground. When the plants stand about ½ inch high, either a little guano water, say about one handful of guano to every three gallons of water, or fine sifted old manure, should be given at least once a week, the remaining days pure water. Should sifted manure be applied, it must be watered at once so as to prevent any damage to the foliage by burning. After the plants are well grown, the covering must be removed at least a fortnight before planting, and watering must cease one week before planting so that the plants may be hardened for their change.

The rate of growth during the first month is very slow, but thereafter at the rate of about 1½ inches per week. A common fault is to sow the seed too thickly. If the plants are dense, it is imperative that they be thinned out—but not before they stand an inch high—otherwise the plants grow thin and lanky and about 25 per cent. to 30 per cent. die off in transplanting. The most important branch in tobacco culture is the raising of good and healthy plants without which a good crop of tobacco need not be expected.

Planting Out.—It is customary in Turkey, when the plants attain a height of 5 inches above the level of the bed and after watering has ceased for a week, to test a plant by twisting it round the finger, and should it not be brittle, the plant is considered fit for transplanting, but if it shows signs of being brittle it must be watered again, after which it must remain a few days without water. When the plants are fit for transplanting, they may be watered the previous evening, so as to facilitate the pulling the following morning. The plants are conveyed in flat boxes or baskets to the field, great care being taken to prevent the roots from drying in transit. It is better to transplant on cloudy days, otherwise the best time is late in the afternoon. As regards distance, it is found best to have the rows 3 feet apart and the plant 8 or 9 inches in the rows, which rows should run in the direction of the prevailing winds. This distance apart has the advantage of permitting cultivation with horse hoe, free circulation of the air, and it also produces straight stems, with a large number of leaves of small but equal size.

The time recommended for planting is during the month of September, and the process, if possible, should be completed within a fortnight, care being taken that all plants subsequently destroyed by cut-worms be immediately replaced, otherwise an uneven crop will ensue, causing great inconvenience and involving extra labour in packing, sorting and grading the leaf. Everything possible must be done to raise a uniform crop, as the expense and work afterwards is thereby considerably minimised and facilitated. It is impossible to conduct curing operations satisfactorily with irregular crops. As before stated, after the first watering given when transplanting, no further irrigation is necessary in localities having a dependable annual rainfall. The actual planting may be done with a dibble, just as cabbages and the like are put in. Backward, worm-eaten and weak drawn-up plants are to be rejected.

Treatment during Growth.—A fortnight after planting, hoeing by hand is necessary, and when the plants are well established and the rows discernible, the horse hoe may be passed through to keep down weeds and maintain a surface mulch. Cease cultivating as soon as priming, viz., the removal of lower waste leaves, is completed.

As the tobacco is liable to suffer from the attack of surface caterpillars (cutworms), etc., trapping with poison should be resorted to as a remedy. The poison may consist of cabbage leaves, lucerne or green barley steeped in arsenite of soda, and scattered over the land towards evening a few days previous to planting.

Mildew is another cause of damage to tobacco, mainly due to climatic influences, but it may be checked somewhat by avoiding damp sheltered and close situations and by allowing free circulation of the air. In the event of mildew, it is advisable to remove the diseased leaves from the field and destroy them, particular attention being paid that no such leaves are threaded with good ones, as such a procedure would ruin the quality of the tobacco.

Tobacco planted early in the season in wide rows running in the direction of the prevailing winds, is not so liable to mildew.

If the seed is sown at the right time, and the flower heads are left undisturbed, very little trouble will be caused by suckers, but if planted out of season and in damp places, these grow vigorously, and reduce the strength of the tobacco very materially. All suckers should be nipped out when between 1 and 2 inches long.

The flowers are on no account to be removed as is done with ordinary tobacco.

Priming.—When the plant commences to bloom, and the lower leaves to turn yellow, four to six of these should be picked, removed from the field and destroyed; in fact, in Turkey eight or ten of the lower leaves are destroyed, although in the Colony to remove so great a number seems unnecessary. Compared with the upper, the lower leaves are weaker, smoother, flatter and thinner. About ten days or a fortnight after the priming—according to the weather—the crop leaves proper commence to ripen.

Signs of Ripening.—The indications of ripeness are;—

(1) The lowest and the oldest leaves show a yellowish tinge in place of the previous vivid green, and this is most obvious towards the tip of each leaf.

(2) A limp feeling instead of the crispness of an unripe leaf.

(3) Translucency in place of the previous opacity when held up to the light.

With Cavvalla and other varieties, when grown on rich soil, yellowish spots appear on the leaves, and when these are distinct, the leaf is ripe. These signs of maturity are much more easily seen before sunrise or in cloudy weather, as bright sunshine misleads the eye.

Gathering the Leaf.—The first illustration will give an idea how the leaf is gathered. Each man takes a single row of plants and the leaves are plucked with the right hand, using the thumb above and two fingers beneath the leaf stalk, the main stem being held firm by the left hand. The leaf is gathered in the early hours of the morning, which not only allows of easier discrimination between ripe and green, but at this time the leaf breaks from the stem sharply without causing injury to the plant. In packing, err rather on the side of over-ripeness than risk taking green leaves. For the foregoing reasons the leaf is harvested from bright daybreak up till 8. a.m. in summer, and until about 11 a.m. on dull and cloudy days. Never under any circumstances gather tobacco after rain till all signs of moisture has disappeared, as the leaf is apt to turn mouldy if this is done, beside losing its oil and gum.

Unripe leaves always retain a greenish tinge, which is very objectionable; overripe leaves lose colour and strength. One or more ripe leaves are plucked from each plant, in no case over four at one picking. The leaves are gathered from the lowest leaf upward in succession. The leaves gathered are placed evenly one above the other, and all facing the same way, in boxes or baskets. Methodical handling at this stage facilitates subsequent treatment. The remainder of the day will be occupied in manipulating the leaves gathered during the morning hours. If left over the day, fermentation is likely to set in. This has happened occasionally (owing to pressure of other work) when the leaves turned black and had to be thrown away.

Threading the Leaf.—The second illustration shows how the threading is carried out. The baskets or boxes, when full, are conveyed to a cool shed where the leaves are graded into two or more grades, according to size. Damaged leaves are set aside. If the leaves are properly sorted at this stage and graded according to size, much time is saved at later stages and a more uniform colour is secured. This matter cannot be too strongly emphasised. Ultimate price depends very much on attention to this one simple detail. Past experiments show that those who neglected this matter were put to much labour and trouble at pressing time. The aim must be to keep the leaves as flat as possible, and if they vary in size the edges become folded and crinkled and a ragged, shrivelled effect is the result. The assorted leaves are now picked up one by one and threaded on to the tobacco needles at a point about one-half inch from the base. The leaves are then passed on to a thread of strong twine about 8 feet long, care being taken to keep all the butts of the leaves at the same level. All leaves must face the same way and be packed close together. A rod is laid along the string of threaded leaves, either end of which is attached to the corresponding end of the rod whilst securing bands, keeping the threads to which the rods are tied on at intervals of about a foot apart. Finally a label is attached to each rod, giving the date of picking and grade of the leaves.

First Step in Curing—The rods with their burdens of leaves are taken to the curing shed and supported at their ends on wooden rails, and the rods should be kept about 6 inches apart on the rails. The aim is to let the leaves wither slowly and turn to a pale yellow colour without moulding or decaying. Under ordinary circumstances this process will occupy from three to four days, including the day of picking, if the leaves were properly ripe before picking. If there is too much draught, the edges of the leaves dry, and shrivel instead of becoming faded and limp.

The curing house proper may consist of any convenient outhouse, clean and cool, and, if possible, with a temperature not higher than 70 degrees. An empty wine cellar or coachhouse will serve the purpose, the essentials being freedom from heat, hot wind, dust, rain and light. Lofts under corrugated iron roofs, stables where animals are kept, verandahs or lean-to sheds exposed at side and front, are to be avoided.

Second Step in Curing.—The third illustration represents the curing camp and the rods hanging on the trellis and lying on the ground.

The greatest care must be taken to prevent the tobacco from touching or rubbing and the rods from slipping along the wire; to prevent this the ends should be secured with strong string. The first day the rods are kept two inches apart, the tobacco being close but not touching, and in the event of a scorching hot day, should be covered by bags or canvas sheets, though for the first day only. The second day the rods are kept about four inches apart, and the third and subsequent days six inches. The object of varying the widths is to expose the tobacco gradually and prevent sudden or too rapid drying and to attain a good colour. The leaves gradually change from a pale yellow to a warm yellow brown colour and become dry to the touch. This process takes usually from 12 to 15 days, subject to the weather.

In the event of threatening, all rods hanging outside must immediately be brought under cover and hung up singly, but not touching, nor must they be taken out again until the weather is perfectly clear. It sometimes occurs that the weather continnes threatening for two or three days and the fresh tobacco may become mouldy. As a preventive, a heating oil stove may be allowed to burn in the curing shed to reduce the dampness in the atmosphere.

The tobacco in the curing camp must be covered without fail every night, dew or no dew, otherwise loss will result.

Third Step in Curing.—When the mid-rib of the leaf is brittle and perfectly dry, the rods are removed from the trellis and laid on the grass or on clean sacking, each one singly, and allowed to remain thus for the whole day and covered at night with bagging to keep out the dew. After removing the sacking the next morning, the rods must be turned, exposing the other surface of leaves to the sun. This is repeated for two days, and on the third morning the tobacco is removed to the shed and stacked.

It sometimes happens that the leaves having been picked a trifle green, or from some other cause, do not colour properly. In such cases they are damped with pure water applied as a very fine mist spray through a spray pump at sunrise. One day the one side is sprayed, the next day the other. This is repeated only once on each side of the leaf. Spraying is not necessary in every case if the pioper colour is acquired without it.

The fourth illustration represents a trolley which is brought in the curing camp for conveying the dry tobacco to the shed. The trolly consists of three stories, each accommodating 30 rods without causing damage to the leaves.

The fifth illustration shows the stacked tobacco on a platform of planks raised about 18 inches from the ground. The tobacco is covered well with sacking to retain its moisture and keep out dust and air. In this state the tobacco may be kept until a convenient time for pressing. Before pressing, in case the tobacco is very dry, a little water may be gently sprayed on to it with an "Abol" syringe or spray pump having a "Vermorel" nczzle, preferably on one side of each rod as it is laid down, where it must then remain at least two days. This permits of the whole mass becoming soft and elastic.

The Baling Press. –Probably any hand baler might be adapted to the purpose of pressing the Turkish tobacco into the form in which it is customarily put on the market, but one specially designed for the purpose, as used in Turkey, is a material advantage and can be improvised at small cost.

A stout wooden platform, 2 feet by 7 feet, is required. Near one end two uprights are erected and joined together by a cross piece, in which a worm and vertical screw is affixed, or other device for exerting a pressure downwards may be arranged. The press proper consists of a box 2 feet by 16 inches by 2 feet, which slides in and out under the screw. One end of the box is fixed to the wooden floor; the other end and sides are attached by hinges, and a wooden frame fits round the top to keep the sides in position. The lid consists of a flat piece fitting just inside the box, and when in operation the pressure is exerted by the screw upon this lid. At any time either side or the one end may be opened without disturbing the rest, and the progress of the pressing process watched and controlled.

Baling.—Pressing may be undertaken at any convenient time after the conclusion of the drying process. The operation is best carried on in wet

weather, when the leaves are supple and elastic in the stack. If the weather is fine and the material dry and crisp, then two days before pressing, the rods are to be lifted one by one and sprayed very finely with water on one side only and re-stacked and covered. The leaf then becomes soft and pliant, but if too much water is used fermentation will take place and the leaf become mouldy, and it will thus be seen that great care must be taken in carrying out this simple but dangerous process. It may here be observed that some growers last season, not having any experience in curing tobacco, or any one to show them, were very unsuccessful in their efforts, and as a result obtained poor prices for their tobacco, or as much of it as could be sold, the majority of these crops remaining unsold owing to the manner in which the tobacco was cured and the excessive amount of water added to the leaf before pressing, causing fermentation and mouldiness in the leaf.

When the tobacco is in a fit condition, the strings are cut from the supporting rod and divided into lengths corresponding to the size of the bale. The tobacco is packed in layers, the butts all turned outwards and the tips towards the centre. When half full, the lid is put on and the pressure applied for a quarter of an hour, after which the box is filled, and for three or four hours the pressure is repeatedly applied, the sides of the box being open occasionally to inspect progress. The usual weight of a bale is 80 lbs. Ultimately the bale is removed and sewn up in canvas, with the ends showing the butts of the leaves left open, at these ends the canvas is laced together criss-cross like a widely laced boot.

In this condition the leaf is stored and improves much with age, tobacco coming out of the bale a year or several years old, being very much superior to the new immatured article.

In Turkey, while maturing, the bales are turned every day, much as is the custom with ripening cheeses.

Accessories Required per Acre (approximate).

(1) Six needles, 14 inches long by about ½ inch broad, flat and smooth with sharp points, and dull edges, provided with an eye, and made of good steel. Obtained at Messrs. J. H. and E. Youle, Long-street, Cape Town.

(2) Six baskets or boxes.

(3) One "Abol" syringe for entire crop.

(4) Five hundred rods, 8 feet long. These may be light wooden spars, bamboo or stout reed, and must be of uniform length, that given, *i.e.*, about 7 feet, being approximately a convenient length.

(5) A supply of canvas sheeting, bags or other material for protecting the tobacco from dew.

(6) A trellis. A simple arrangement consisting of two parallel wires about 7 feet apart, supported at intervals or short stakes to prevent sagging, and carried along about 2 feet above ground and made fast at each end. The trellis wires should run across the direction of prevailing wind. A separate set should be provided for each quality of tobacco. The site of the trellis should be some convenient sheltered and sunny spot, preferably in a grass camp, but protected from wind and the prying attention of livestock and fowls.

(7) A supply of butter cloth for covering the seed beds.

EDIBLE PRODUCTS.

THE FERTILIZATION OF RICE.

(From the *Louisiana Planter and Sugar Manufacturer*, XLII., No. 5, January 30, 1909.)

Rice being an aquatic plant, it has been a debatable question as to just how to secure the best crops of it. In Louisiana it has become the general conclusion that almost any sugar plantation can be utilized successfully for two or three years in rice culture, and the more successfully because of the fact of the land having been in cane culture. This can hardly be because there is any improvement in the soil because of cane culture, other than the fact that cane culture, being a very intense culture, leads practically to the extirpation of all of those grasses which become so annoying in rice culture and have it yet to learn. On the other hand, we know from actual experience that lands that have been planted in cowpeas, the cowpeas ploughed under and the lands thus intended for sugar cane subsequently diverted to rice culture, have produced crops of rice almost unheard of in quantity, and in fact to the exten

of over 30 barrels per acre, the barrel being 162 lbs. of rough rice, including the sack. This would seem to indicate that the nitrogen accumulated from the air and into the land by the leguminous crop had a very positive effect upon the rice planted upon such lands, Apart from this, it has been noted that where there has been stable manure dropped on the land, the manured spots showed a rapid and early growth of the rice, even though it is an aquatic plant and grows with its roots in the water.

The *Gueydan News* now reports the facts about the fertilization of a tract of rice land in that vicinity. Messrs. Riley & Neelis own a rice farm three miles North-West of Gueydan. Last year they planted and fertilized six acres, keeping it entirely separate from the rest of their fields. This six acre field yielded twelve bags to the acre, and each bag weighed 203 pounds, which would be equal to fifteen standard bags of rice per acre. In the milling of this rice it was found to yield 108 pounds of head rice, the broken rice and other offal not being included. The rice brought the top of the market price and the gross yield was $57·60 per acre.

These results were carefully compared with those obtained from the land lying alongside, which was not fertilized, but which had otherwise received exactly the same treatment. This yielded only 9½ bags to the acre, each bag weighing 185 pounds of rough rice, and that the rice mill yielded 100 pounds of head rice, which sold for $3·50 per standard barrel, the gross proceeds being $31·50 per acre. It was not stated whether the rice was harvested and marketed at the same time, nor whether or not there had been any change in the market price. It may be left fair for us to infer that the best rice was sold for seed rice, and hence brought the fancy price. It, however, was evidently very heavy rice, the bags being of the same size, of about five bushels each, and the fertilized rice weighed 203 pounds to the sack, indicating a very large amount of rice kernel and less of rice hull than the other, which only weighed 185 pounds for the same measure, and had a less yield in clean rice to the extent of eight pounds per bag.

In the description of the transaction, in giving the yields stated, the yields of 108 pounds and of 100 pounds of head rice are stated as being this much per bag, but it is not stated whether the bags of 203 pounds and 180 pounds respectively were meant, or whether the standard bag or barrel of 162 pounds meant, when the yield of 108 pounds and 100 pounds respectively was reported.

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If these data are all accurate as given and the difference of the gross proceeds per acre actually amounts to $26·10, it is a striking instance of the value of whatever fertilizer was used in this instance.

TEA CULTURE.

EXPERIMENTAL WORKS AT HEELEAKA.

(From the *Indian Agriculturist*, Vol. XXXIII., No. 12, December 1, 1908.)

GREEN MANURES.

The following are the concluding portions of Dr. C. M. Hutchinson's interesting report on the investigations carried at the Heeleaka Experimental Station during 1905, 1906, 1907. Dealing with the question of green manures Dr. Hutchinson says :—

One of the most interesting points in connection with the use of green manures in tea culture is the very wide divergence of opinion as to their values ; this suggests at once that in certain soils and climates their effects are not sufficiently marked to be obvious ; whereas, under different conditions obtaining elsewhere, no doubt arises as to their efficacy. Another reason exists for this difference of opinion, and that may be said to be due in some cases to want of knowledge of what a good crop of such green manure as Mati Kalai is really like ; in many soils this plant makes such a feeble growth that, as a green manure, it is practically valueless, and planters who have only seen it under these conditions very naturally have a low opinion of its use. It is unfortunate that the Heeleaka soil is of this character, and this has made it necessary to give a preliminary dressing of manure to all the plots under treatment with green crops, in order to get sufficient growth of Mati Kalai to serve for comparison.

The increased yields of leaf produced by the use of green manures are very small when compared with other manurial treatment ; the increase on these plots, however, was decided enough to show the value of such treatment, besides indicating the relative advantages of the various crops experimented with, and it cannot be too often insisted upon that the principal object of growing green manures is not so much directly to increase the yield of leaf, as to improve the condition of the soil both mechanically and chemically, by replacing organic matter which the ordinary processes of growth and cultivation tend to remove, no rotation of manures being complete without the inclusion of a green crop in the series. In the case

of these plots a more accurate idea of this action of the green crops may be obtained by consideration of the relative yearly improvement of the plots than by comparison of the total weights of leaf taken from them.

IMPROVEMENT OF THE PLOTS.

By far the most improvement has been shown by Plot No. 6 on which Arahar has been grown for three consecutive seasons; this may, I think, be ascribed to the large amount of organic matter produced and the method of introducing it into the soil, which consisted in trenching the alternate rows and burying the whole year's growth in the trenches. The improvement in the texture of the soil due to this method of treatment is very marked, and the condition of the bushes is equally altered for the better, the strong growth of new wood promising well for the future continuance of their vigorous condition. The method of growing Arahar in teas is very similar to that in use for *Tephrosia candida*, except that the latter is generally left to make two or three years' growth before being cut down and buried, whereas in the experiment plots the Arahar has been hoed up and buried at the end of each season, a fresh crop being sown in the following spring.

Tephrosia candida (Boga Medeloa) was not included in the original scheme of green manuring, but has been planted in the new clearance with great advantage to the young tea, and two plots are now under treatment with this plant in the green manure series.

One other very important action of green manures is the fixation in the soil of nitrogen derived from organic matter; this nitrogen, originally present in an insoluble form in the humus, is rendered soluble by the action of soil bacteria, and, as this change probably takes place to some extent even in the cold weather, the resulting nitrates are liable to be removed by the first spring rains beyond the reach of the roots of the tea bush, the activity of the latter at this early part of the season not being sufficient to allow of their absorption as fast as they are formed. A good crop of green manure, however, will be able to take up a considerable amount which would otherwise pass into the drainage water, retaining the nitrogen for use by the tea-bush later in the season; and although in many soils under tea, and especially such as are in a good state of cultivation, much of the nitrate carried down into the subsoil by rainwater is probably returned to the surface by capillary rise of the latter, yet, a great loss of nitrogen in this condition must inevitably occur, which green manures grown at this season of the year would help to diminish. It is also probable that the ordinary processes of nitrification of organic matter are considerably modified and reduced during the period of growth of a leguminous crop, and this would account to a great extent for the falling off in yield of the tea bushes, whilst the land was occupied by such green manures as Matai Kalai and Dhanicha, and emphasises the necessity for limiting such occupation to the shortest time consistent with the production of a fair crop of the green manure.

PRUNING.

These experiments were designed to obtain information as to the best methods of light pruning old tea. Six plots of one acre each were laid out, and the following styles of pruning were adopted :—

Nos. 1 and 6 were treated in accordance with the local method of light pruning, no cleaning out of weak shoots or laterals being done.

No. 2. This plot was thoroughly cleaned out both at the sides and centre of the bushes and no weak laterals were left.

No. 3 was "Table" pruned, *i.e.*, cut straight across, leaving two inches in the centre, but no cleaning out was done.

No. 4 was similarly treated, but four inches of wood was left.

No. 5 was pruned on the "Baghjan" system, that is practically all the new wood was cut out, the new growth being intended to come away each year from the same point, thus forming a knot which yearly increases in size. Owing to the great age and mixed character of the bushes of these plots, it has been found impossible to carry out this system in the same way as that which has been adopted at Baghjan itself, but the approximation has been sufficiently close to allow of comparison. Owing to want of vitality in many of the bushes many stems have died back from the pruned knot, necessitating a certain amount of cutting back, so that the general effect is due partly to the individual style of pruning and partly to the system aimed at.

There was a very marked difference in the yields obtained from the various plots; those on which the Table pruning was adopted demonstrate very clearly the failure of this method to stimulate vigorous growth, and should be sufficient to convince the most conservative of its character. It has been found necessary in consequence of the weedy character of the harmful growth produced on these two plots, to abandon this method of

pruning them and to cut back the bushes; it is not anticipated that any such hard pruning will be necessary on the cleaned out plots for some years to come.

The general character of growth on Plot No. 2 compares very favourably with the table pruned bushes, and also with those on the control plots, Nos. 1 and 2; the healthy appearance of the bushes, which is very noticeable, was further in accordance with their freedom from red rust, which was prevalent on the table pruned plots and also on the control plots, where the small twiggy shoots and ill-nourished laterals afforded favourable opportunities for the development of this disease. Thread blight was altogether absent from this plot, although many Table pruned bushes suffered from its attacks, and on the whole it may be said that this method of pruning has completely justified its adoption as a means of keeping up the yield of the bushes, and of rendering them less liable to such diseases as red rust and thread blights. There can be no doubt that, in dealing with other blights such as mosquito, this method would allow of more successful adoption of the appropriate remedial measures, besides rendering the bushes themselves more capable of resisting attack.

PLUCKING EXPERIMENTS.

The experiments on plucking have been confined, so far, to an attempt to determine the relative merits of the "Sadiya Road" system, and that in vogue in other districts; the former method consists in plucking at intervals of ten or more days, and taking all growth above the number of mature leaves which it has been decided to leave for the time. Plots Nos. 8 and 10 of one acre each were plucked in this manner, whereas only the fully formed two leaves and bud were taken every seven days on Nos. 7 and 9. This experiment has now been in operation for three consecutive seasons and certain conclusions can be drawn from the results. At the end of the first season, 1905, seventeen pluckings of ten-day leaf had yielded half a maund per acre more tea than twenty-two pluckings of seven-day leaf; inspection of the bushes after pruning, however, led to the conclusion that the excessive drain on their resources, exercised by this style of plucking, had produced an unhealthy and exhausted condition, and this surmise was borne out by the fact that, in the second year of the experiment the first season's gain was not repeated, the two styles of plucking producing the same amount of leaf. A further loss of condition was apparent, and although the yield of the whole four plots was increased by an application of cattle manure in the cold weather of 1906, the ten-day plots failed to regain their former position, although the stimulus of the manurial dressing prevented any further comparative deterioration in crop. The local Advisory Committee, on inspecting these plots at the end of the third season, were of opinion that the results obtained, taken in conjunction with the condition of the bushes, demonstrated clearly that, in such soil and climate as obtain at Heeleaka, this method of plucking is bound to result in deterioration of the tea, with no correspondingly great advantage either in increased crop or improvement in quality. It was therefore decided to abandon this experiment, and to utilise these plots for other purposes.

BONE MANURES.

Experiments on the manurial action of bones were commenced in 1907 on a series of plots laid out on young tea of good "Jat." The plots were treated with ¾ inch bones, bone meal, and dissolved bones, and control plots were included in the series manured with oil-cake and with a mixture of oil-cake and superphosphate, containing amounts of phosphoric acid and nitrogen equivalent to those provided by the bone manures. No manurial effect was observable at the end of the season, but these experiments will be continued in 1908, with a view to observing any differences that may arise from the gradual action of the bone manures.

An account of the experiments now being carried out at Heeleaka, and those which it is proposed to undertake, has been published in the programme of work for the Experimental Stations for 1908. I would cordially invite suggestions from planters, says Dr. Hutchinson, as to problems needing investigation and expression of their views as to the practical application of the results which have been obtained at Heeleaka.

COMMERCIAL ORANGE PRODUCTION IN THE PHILIPPINES.

BY WILLIAM S. LYON.

(From the *Philippine Agricultural Review*, Vol. I., No. 2, February, 1909.)

Inquiries for buds or scions of improved varieties of American or European oranges are so frequently addressed to the Bureau of Agriculture that, as

a matter of general interest and information, a brief résumé of the experiences of the Bureau with these varieties is here made public.

Early in 1902 the standard sorts in common cultivation in Florida, California, Matta, Italy, and Japan were introduced and planted at Malate, Manila at sea level; also near Abucay, Bataan Province, at an elevation of about 200 meters; and at La Trinidad, Benguet, at an altitude of 1,500 meters, The story is best and most briefly told by saying that the results have been so far most disappointing. The trees were, in trade jargon, "two-year buds" and are now approximately 6 years old, and under fair condition should be producing one and one-half boxes (200 to 300) oranges per tree. The Japanese varieties are the only kinds that have proven productive, but the fruits have deteriorated so badly as to be hardly edible, and are practically worthless.

Of the other foreign varieties, those planted in Benguet Province have nearly all died, and those in Bataan, though grown upon an inviting-looking soil with good drainage and protection from high winds, have fared but little better. In Manila, the trees of most varieties have made a fair growth, but only one tree (a St. Michael sweet) has matured any fruit, and of that only to the number of three. The Valenica late, Malta blood and the famous Washington navel have, up to the age of six years, not fruited. The three fruits of St. Michael sweet were quite up to standard in all respects, expect colour, remaining bright green when otherwise perfectly mature. This last feature was to be expected; and, while we are not prepared to say that there are no places in the Philippines where these foreign varieties may not prove productive, the prospective planter should fully realize that he cannot hope to produce anything but bright-green uncoloured fruits. This, from a commercial aspect, is a more serious defect than is apparent at first glance. The eye does much to influence the palate, and the influence is clearly shown in higher price generally brought for the brilliant, highly-coloured California navels over the intrinsically finer fruits from Jamaica and Florida, handicapped as these latter are by the dull greenish russet colour which characterizes oranges grown in the Tropics.

This feature is common to the Philippines as well as to all tropical countries. We see it in the closed-skinned "cajel" so common througout the Visayas and in the free-skinned tangerine or "naranjita" so abundant at certain seasons in our markets.

These oranges are at their very best while still bright green. When beginning to colour, as they do toward the close of the season, it is an index of incipient decay which may not be exhibited in disintegration or in anything worse than loss of juice and flavour.

The experiences of all orange-growing countries conclusively show that the orange, although cosmopolitan in the mere matter of existence, is most fastidious in the soil requirements which bring its fruit to perfection. Witness the heavily loaded trees in and about Santa Barbara, California, whose fruit is discarded while the local markets are suppiled with fruits brought from Los Angeles and Riverside counties—100 or more miles away. Nearer home, note the superlative excellence of the naranjitas grown at Tanauan and at Santo Tomas, and observe how utterly inferior is the fruit of the same tree grown at near-by Calamba, and still worse on seemingly like soil at Lipa—less than 15 kilometers distant.

On this account it is not denied that in this particularly favoured district satisfactory results may be achieved with imported varieties of oranges, with the odds nevertheless greatly in favour of better success being obtained through careful selection and cultivation of the native tangerine. It is not claimed that this orange is free from defects, but these defects could be partly eliminated in a single generation of careful seed selection in the orchard. In the commercial essentials of productiveness, juiciness, flavour, and shipping qualities, these oranges are unexcelled; and the selected fruits of Santo Tomas or Tanauan at their prime are superior to the showy but insipid California fruit that reaches this market in cold storage.

From ex-General Malvar, a large grower in Batangas, we learn that there are many thousands of hectares of typical orange lands still unplanted to orchards, which offer an inviting field to the planter; especially to the one who would grow only selected stocks, and improve a little on the spontaneous methods now in vogue. The writer saw a single tree in Tanauan, the crop of which sold for P10 on an estimated yield of 2,000 oranges, or one-half centavo per orange. As a few dozens of selected fruits from this tree sold for 24 centavos per dozen, there is hardly a doubt that, had the tree been thinned down to one-half (which could have been done at a cost of less than P1), the remaining thousand fruits would have found a

quick sale at 1½ to 2 centavos apiece, giving a net return of P14 to P19 for the tree instead of P10.

The orchard value of these fruits, "as they run" in seasons of great abundance, is seldom under P5 per 1,000, and more generally is P8 to P10, rising to double these figures in time of scarcity. The grower need scarcely consider the question of a surplus and consequent glut. The Chinese are exceedingly fond of these oranges and there is a ready export market to Hongkong for many million fruits, whenever the price falls low enough to permit of shipment and still leave a handsome margin for the producer.

CARDAMOM CULTIVATION IN SOUTH MYSORE.

By D. J. Evers,
Forest Ranger, Manzarabad Range.

(From the *Indian Forester*, Vol. XXXIV., No. 11, November, 1908.)

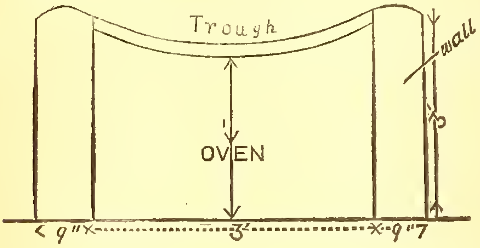
In the Manzarabad and Belur taluks of the Hassan districts, Mysore State, and more especially in the Ghat forests of these taluks, the cardamom plant is cultivated extensively. Messrs. Middleton and Brooke-Mockett, said to be the two largest cardamom planters in South India, have several hundreds of acres under cultivation, while there is scarcely a coffee estate which cannot boast of its "hanal" or "kool," however modest in extent. The word "hanal" and "kool" mean a valley or watercourse. The cardamom plant and the leech revel in moist localities (of which there are enough in the Ghat forests), but the plant, it is said, will not thrive on southern and western aspects. In the Ghat forests the plant comes up spontaneously, wherever a little light has been admitted by the felling of a few large trees, and superstition attaches much virtue to the Balagi (*Poeciloneuron indicum*), the Dupa (*Vateria indica*), the Halmaddi (*Canarium strictum*), and the Naga Sampige (*Messua ferrea*). The ryot does not seem to be quite sure as to how the plant suddenly makes its appearance, but the general belief is that the seed is disseminated by monkeys, rats and snakes! This belief about the snake seems to be on a par with that other, about the peevit sleeping on his back with his legs raised high to prevent the sky falling on him!

There are two methods of cardamom cultivation—the Brooke-Mockett and Middleton method, and the Coorg system. In the former (I quote from the Inspection Note of the Conservator of Forests in Mysore) the *modus operandi* "is to thin out the forests by removing small poles to such an extent as to let in the required amount of light, and to plant the area thus cleared with nursery-raised seedlings." This done, if facilities exist for the purpose, the area is irrigated, otherwise the area is simply weeded. In the Coorg system "a careful selection is made of suitable areas, such localities being indicated by the presence of plants which have come up spontaneously. In February and March clearings of one square chain, more or less, are made in the selected locality, taking care to fell only small poles from 2 to 3 feet in girth and brush wood. One or two large trees standing by the sides of the cleared plots are then felled right across it, the object of which is two-fold—first, to let in more light; and secondly, to loosen the soil and thus cause the dormant seeds to germinate. The plots are made at intervals of 2 to 10 chains so as to not open out the leaf canopy too much in one place. The seedlings make their appearance at the first burst of the monsoon, and by the close of the monsoon attain a height of 3 or 4 inches. At the beginning of the following monsoon they are thinned out wherever they are over-crowded, and blank spaces are stocked. All that need be done in subsequent years is to keep the plots clear of weeds. The plants begin to crop in the fourth or fifth year, according to the richness of the soil, and give full crops in the seventh year. They continue to produce good crops till the fourteenth year, when they begin to decline, languish, and die. Then one or two large trees standing by the side are again felled right across the plot. The plants at once begin to revive, and the rhizomes throw out new shoots. This process is repeated every seventh year, and thus renovated the plots last many years. Little or no crop is collected in the years in which the renovation fellings have been made". In the former system of putting out nursery-raised seedlings or bulbs: "This is the Brooke-Mockett and Middleton system, but it hardly commends itself, even though the plants begin to crop earlier, inasmuch as it is more expensive than the Coorg system and the plants cease to yield sooner. Moreover, as rightly remarked by the Conservator of Mysore, the Coorg system causes the least injury to the forest growth," and, therefore, the risks of interference with the rainfall, or with the head-water of streams, are reduced to a minimum.

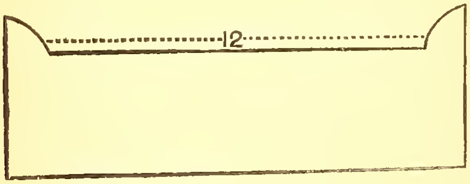
There are two methods of drying the produce—spreading it on mats or in tin trays and exposing it to sunlight, and

drying it over a fire. The oven is a long, brick-and-mud structure, the roof of which is either zinc sheeting, or a thin mortar trough, like a long pot-tile. I saw the latter kind of oven at a village named Bimbli, and I hope the accompanying diagram may explain what it is like. As soon as the zinc sheet or mortar trough is sufficiently hot, a cloth is laid on it and the fruit spread thereon. The object of the cloth is to absorb the moisture, but it is not always used. After the fruit is dried, the stalks are cut off, and the produce is then ready for the market. The fruit is not collected till the covering is a white-yellow colour and the seeds nearly black.

CROSS SECTION.



ELEVATION.



Cardamom is a produce which finds a ready sale locally, and during the cold months of the year, a class of people called "Beris," come across from South Canara and buy up large quantities of it. The Hindus pickle the tender green fruit, while in the dry stage it is much used in their confectionery. In Coorg, it would appear that the Forest Department leases out certain plots of forest land for cardamom cultivation for periods of 14 to 21 years, and in this way realizes an annual revenue of Rs. 2,000 to Rs. 3,000, and if the Mysore Forest Department will do likewise, instead of playing at Cardamom cultivation by departmental agency, as it is now doing, it too might realise similar amounts, instead of insignificant fractions of those figures. Cardamom cultivation should, I think, be left to private enterprise, as in the case of coffee, and I am sure that the planting community of Mysore is quite as enterprising as that anywhere outside the State.

"Hanals" and "Kools" in forests which are not reserved are sold by the Revenue Department by auction, and fetch Rs. 30 and upward per acre. The land, of course, then becomes the private "holding" of the highest bidder, and he has thereafter to pay an annual assesment of Re. 1-1-0 per acre. I do not know what objection there would be to following the same procedure in the Ghat State Forests which are at present practically unworkable for timber for want of roads. But I leave the matter there.

Saklaspur, Mysore State,
13th August, 1908.

TIMBERS.

A PHILIPPINE SUBSTITUTE FOR LIGNUM VITÆ.

(From the *Bureau of Forestry, Bulletin No. 9, Manila, Philippine Islands.*)

One of the most valuable woods in the world is Lignum vitæ (*Guajacum officinale*, L.). The greater part of the market supply is obtained from the West Indian islands. During recent years, heavy and indiscriminate cutting has so depleted the forests of this tree that manufacturers are at present seriously engaged in the search for a suitable substitute.

There are many excellent hardwoods in the Philippine Islands, but only one species possesses the qualities necessary to allow of its use in place of Lignum vitæ; that is, Mancono (*Xanthostemon verdugonianus*, Naves). This wood, it is believed, can be used to advantage in the manufacture of a number of articles made at the present time exclusively from Lignum vitæ.

In order that the similarity of structure of these woods may be more clearly understood, a short description and a comparison of the two species follows:—

LIGNUM VITÆ (*Guajacum Officinale*, L.).

The heartwood of Lignum vitæ is greenish brown, and the sapwood a bright yellowish colour. It is very heavy and hard, with a specific gravity, when air-dry, of from 1·17 to 1·39. The grain is fine, and the wood fibres small

and exceedingly twisted, thus making the wood very difficult to split.

MANCONO (*Xanthostemon verdugonianus*, Naves.)

The heartwood of Mancono is brownish, turning purple when exposed to the air; the sapwood is very narrow, and of a pale reddish colour. The wood is very heavy and hard, having a specific gravity, after drying for fifty-nine hours at a temperature of 105° to 110° C. of 1·236, equal to a weight of 77 pounds per cubic foot.* The grain is fine and twisted, and the fibres rather short and exceedingly thickwalled. The hardness of the wood is due mainly to the thick-walled fibres, but partly also to deposits in the vessels.

COMPARISON OF MANCONO AND LIGNUM VITÆ.

Botanically, these two species are not closely related. In colour, the woods differ materially. Lignum vitæ also has a resinous odour distinct from that of Mancono.

Sufficient tests have not been made to allow of an accurate comparison as to weight and hardness. Lignum vitæ will probably average a trifle heavier than Mancono; the Philippine species, however, being the harder.

The grain of both woods is fine and twisted, but the West Indian species has much the finer grain, and is therefore more difficult to split. In structure, Lignum vitæ differs from all known woods in the weave of its fibres, which are noticeably smaller than those of Mancono.

The seasoning qualities of Lignum vitæ are unknown. Mancono checks badly upon exposure to the air, the cracks, however, being superficial. From the coarseness of the fibres, it is to be expected that this species would suffer somewhat in seasoning.

Summarizing, it may be said that Mancono is evidently inferior to Lignum vitæ in some respects, but that it has enough good qualities to indicate that it may be utilized, profitably, as a subtitute.

DISTRIBUTION OF MANCONO.

Mancono, one of the important first-group trees, is found in the southern islands of the Philippine Archipelago, commercial forests being restricted to the coast hills of the Surigao Peninsula, and Dinagat, Bucas, and adjacent islands, in the Provinces of Surigao and Agusan, Mindanao, P.I. As the tree has never been extensively exploited the many excellent qualities of the wood are but little known to the general trade, though the timber is highly prized by the Filipinos of the south on account of its durability and freedom from the attack of white ants.

A conservative estimate places the total area of Mancono forest suitable for logging, at 2,000 hectares (4·942 acres).

* The weight of air-dry wood varies from 80 to 90 pounds per cubic foot.

DISCRIPTION OF THE FOREST.

On steep, rocky hillsides, rising sharply from the beach, it is usual to find Mancono in almost pure stands, to the practical exclusion of all other commercial species. In such situations, where the soil is a dry, compact, reddish clay, the tree attains maximum development.

From a distance, Mancono can be easily distinguished by its rugged branches, small leaves, and thin, spreading crown. The tree flowers in May, the blossoms being bright crimson in colour. The bark of the tree is slate-white, peeling in irregular flakes simillar to the Sugar Gum (*Eucalyptus curynocalyx*) of Australia. It is very thin and easily removed from the log after felling.

The trees are rarely buttressed, but the bole is irregular in shape, and tapers rapidly. The maximum recorded diameter, breast-high, is 115 centimeters (45 inches), and the maximum clear length 10 meters (33 feet). The average clear length of fairly straight, merchantable trees varies from 5 to 8 meters (16 to 26 feet). It is estimated that 50 cent. of the trees measured on the Island of Dinagat, Suriago Province, had a trunk divided within 2 or 2·5 meters (6½ or 8 feet) from the ground, in many cases the fork occurring at a distance of from 60 to 90 centimeters (24 to 35 inches) above the base of the tree.

Table I. gives the average stand of Mancono per hectare, and per acre, as obtained from valuation surveys in a practically pure stand.

Table I.—NUMBER OF TREES PER HECTARE, AND PER ACRE, OF MANCONO, DIANAGAT ISLAND, PROVINCE OF SURGAO, MINDANAO.

[Average of 4 hectares (9·88 acres.)]

Diameter breast-high.		Number of trees.		
Centimeters.	Inches.	Per hectare.	Per acre.	Per cent.
13 to 30	5 to 12	106·7	43·2	86
31 to 60	13 to 24	48·3	19·5	
61 to 90	25 to 35	20·0	8·1	14
Over 90	Over 35	5·8	2·3	
Total	...	180·8	73·1	100

In the above table, 86 per cent. of the trees are under 60 centimeters (24 inches), a minimum diameter limit prescribed in the cutting rules for certain forest tracts where first-group woods are protected.

With logging under the supervision of a forest officer, this limit could probably be lowered to 30 centimeters (12 inches).

As previously stated, Mancono usually grows in pure stands, to the exclusion of all other merchantable species. Near the upper limits of the type, however, such hardwoods as Yacal (*Hopea plagata*), Batete (*Hardwickia alternifolia*), and Sudiang (*Eugenia sp.*) etc., are occasionally found. These species are widely scattered, and of little importance.

On account of the steepness of the slopes on which Mancono grows, litter and humus are rarely present. The underbrush is usually dense, consisting of a heavy stand of seedling trees, vines, and herbs.

Reproduction is abundant in all situations, although the growth is slow on account of the quality of the soil of the locality. Surveys made on plots $\frac{1}{400}$ of a hectare in area give an average stand of 14 saplings, 2·5 to 10 centimeters (1 to 4 inches) in diameter, per plot, or 5,600 per hectare (2,266 per acre). The actual amount of reproduction is greater than indicated by these figures, as in the surveys no account was taken of seedlings.

MERCHANTABLE VOLUME.

From data available at the Bureau of Forestry, the merchantable volumes of trees of different diameters has been roughly computed, and from these the yield of Mancono per hectare, and per acre, ascertained. These volume figures, however, are based upon the clear length of the bole only. Almost all trees have large branches which would furnish short logs or bolts of merchantable value. No figures on the volume of such wood have been obtained.

The average and total yield of the Mancono forest, based on a cutting diameter of limit of 30 and 60 centimeters (12 and 24 inches), is given in Tables II. and III.

Table II.—AVERAGE YIELD IN MANCONO FOREST.

(Average of 4 hectares (9·88 acres.)

Minimum cutting diameter limit.	Average yield per hectare. Cubic meters.	Cubic feet	Pounds.
30 centimeters (12 inches)	45·00	1,590	127,200
60 centimeters (24 inches)	33·40	1,180	94,400

Minimum cutting diameter limit.	Average yield per acre. Cubic meters.	Cubic feet.	Pounds.
30 centimeters (12 inches)	18·21	643	51,440
60 centimeters (24 inches)	13·52	477	38,160

Note.—1 cubic foot = 80 pounds.

Table III.—TOTAL YIELD OF MANCONO FOREST.

[2,000 hectares (4,942 acres.)]

Minimum cutting diameter limit.	Total yield. Cubic meters.	Cubic feet.	Pounds.
30 centimeters (12 inches)	90,000	3,180.000	254,400,000
60 centimeters (24 inches)	66,800	2,360,000	188,800,000

Minimum cutting diameter limit.	Total yield Cubic meters.	Cubic feet.	Pounds.
30 centimeters (12 inches)	36,420	1,286,000	102,880,000
60 centimeters (24 inches)	27,040	954,000	76,320,000

LOGGING.

Extensive logging opperations have never been carried on in the Mancono stands of the Philippines. The wood, though prized by the natives, is rarely used on account of the difficulty of felling the trees. To cut a 70 centimeter (28 inch) tree, with the crude axes manufactured by the Filipinos, usually takes two days. To fell a tree of equal diameter, with a saw, requires only four hours. Diamond-point saws should be used exclusively, on account of the great hardness of the wood. If extensive operations are undertaken, all trees should be cut as close to the ground as possible in order to obtain butt logs of large diameter. The taper of the first two meters (6½ feet) of the bole is very rapid.

As Mancono grows on steep hill sides along the coast, the logs can readily be skidded to the shore by means of a small yarding engine located on the beach, or transported down a rollway or dry slide. The maximum length of haul would rarely exceed 200 meters (610 feet). To transport logs to a steamer from the beach, it would be necessary to load them into large, shallow-draft scows, or native "lancans" (dugouts).

Suitable locations for camps are found along the shore, or in the woods. Corrugated iron roofing may be used to advantage in the construction of shacks, on account of the scarcity in this region of the nipa palm, the leaves of which are ordinarily used for thatching purposes in the Philippines. Water, in sufficient quantity to supply a camp, is rarely found in the immediate vicinity of a Mancono forest, although never far distant.

Labour.

To carry on extensive logging operations in the Mancono stands of Surigao and Agusan Provinces, it would be necessary to import workmen from the nearby Visayan Islands, on account of the scarcity of local labour. Foreman, acquainted with the woods and the location of the heaviest stands of timber, could probably be obtained from Dinagat, Surigao, and various other coast towns. The daily wage would vary from P0·75 for ordinary labourers, to P1·50 for expert axmen or sawyers. Gangbosses are usually paid P50 per month, and the head cook in large camps P40. In addition to the above wages it is necessary to provide food for all labourers. The average cost of feeding the men is about P0·16 per day. The necessary American foremen, etc., should be secured in the United States.

Filipinos, when given fair treatment, make fairly steady and permanent workmen. They are quick to learn how to handle machinery, and work well in the woods. With patience and a knowledge of local customs, excellent results may be obtained.

Cost of Logging.

Table IV.—Gives the estimated cost, per cubic foot, of cutting and transporting Mancono to New York.

	Estimated cost.
Cost of felling and hauling to beach	P. 0·11
Loading on shipboard ...	04
Government stumpage ...	07
Freight to New York via Suez	40
Incidental expenses ...	16
Total ...	*·80

* P0·80 per cubic foot of 80 pounds or $10, United States currency per ton.

Note.—P2=$1, United States currency.

Transportation.

Any company undertaking to market Mancono on a large scale should make definite arrangements for the transportation of all timber direct from the southern islands of the Philippines to New York. To tranship logs at Manila would add materially to the cost.

There are a number of good anchorages for large boats near the various forests to be logged, or if necessary, a central timber depot could be established at Surigao, and all logs brought to this point and loaded directly into the steamer from a dock.

From November to March, inclusive, it would be impossible to carry on loading operations along the Pacific coast of Mindanao and adjacent islands, on account of the north-east monsoon; a similar condition prevails along the west coast of the Surigao Peninsula, and of Dinagat Island, from about July 15 to October 15, at which time the south-west monsoon is blowing. The port of Surigao is, however, open throughout the year.

Tests of Mancono.

Mancono is the hardest and heaviest of Philippine woods. It is practically impervious to decay, and is not subject to the attack of anay (white ants), or the sea worm (teredo). Posts, 40 years old, examined in the town of Dinagat, Province of Surigao, were found to be decayed only to the depth of 1 centimeter (0·4 inch), and that only in the sapwood at the point where the post entered the ground. Piles which had been in salt water at Surigao for several years, were found untouched by the teredo, although ordinary hardwoods are readily destroyed.

The only official tests of Mancono to date was made at the United States Naval Station, Cavite, P. I. The wood was installed, on side grain, as a bearing for journals rotating in salt water, in the stem bushing of a small launch which was in constant use. At the end of seven months the bearing was split out for examination. The wood was found to be but little worn, and was reported by the commander of the naval station to be "quite the equal of Lignum vitæ, when both are used for bearings on side grain."

In the manufacture of rollers, pulleys, toolhandles, bowling balls, tempins, bearings, etc., it is believed that Mancono can be used profitably. The supply, though limited, can, by methods of conservative logging, be made to last for an indefinite period. Not only is this species found in merchantable sizes and quantity, but it can be cheaply exploited. As a substitute for Lignum vitæ, it is at least worthy of a trial by all hardwood manufacturers.

The Bureau of Foresty will furnish, on application and without charge, samples of this wood. Requests for samples should state form and dimensions desired.

HORTICULTURE.

PETRÆA VOLUBILIS.

No member of the vegetable kingdom can surpass, and few can equal, the exquisite beauty of this plant when in full flower. The blossoms which are heliotrope with a violet centre, are borne in loose pendant sprays (racemes), which are hung gracefully from the slender arching branches. These combined with the rigid green leaves suggest almost a perfect artificial blossom, and the beau ideal of the milliner's art. The plant is a woody climber, native of Tropical South America and some of the West Indian Islands. There is no record of its date of introduction at Peradeniya, though this cannot obviously be far back. It bears a few seeds occasionally at Peradeniya, but these need not be depended upon for propagation, as cuttings; if inserted in the rainy weather, will grow readily. The plant is seen to best advantage when allowed to ramble of its free will amongst the branches of a low spreading tree. But it may also be grown, with much effect, by itself as a bush, or over an old tree stump. A white-flowered variety of *Petrœa* is found in British Guiana, Trinidad, etc. There is also a tree-form (*Petrœa erecta*) indigenous to the same habitat. This has been introduced and established at Peradeniya, and promises to become an acquisition to the Island's most beautiful flowering trees.

H. F. MACMILLAN.

PLANT SANITATION.

ENTOMOLOGICAL NOTES.

BY E. ERNEST GREEN,
Government Entomologist.

Branches of Camphor, injured by a small Scolytid beetle (allied to the 'shot-hole borer' of tea) have been received from the Ambawella district. The same pest was reported from Hewaheta in November, 1906 (See *T.A.*, December, 1906, p. 42). In the present case the trees had been killed by root fungus (Rosalinia); but this little borer undoubtedly attacks healthy trees also. The mycelium of a fungus subsequently develops in the galleries of the insect, penetrating the woody tissues for a considerable distance and often killing the bark round the entrance to the tunnels. The branch may be completely ringed by these diseased areas. The presence of the pest is marked by dark brown patches on the bark. The pest should be kept in check by cutting out and destroying the affected branches. If a still is in operation, there is nothing to prevent the diseased branches (which still contain camphor) from being utilized for distillation.

The cotton (*Gossypium*) plots, on the Experiment Station, are badly infested by the 'Pink Boll-worm' (*Gelechia gossypiella*, Saund). Nearly every pod appears to be infected. This is the first crop and the first occasion upon which cotton has been grown here. Nor is there any wild—or half wild—cotton on the place. This insect is—to the best of my belief—confined to the cotton plant. Under these circumstances, it is difficult to understand how the pest has appeared in such enormous numbers. It can scarcely have been introduced with the seed,* as the eggs are laid on the immature seed pods. It is possible that the insect breeds also in the fruit of some allied malvaceous plant; but I have been unable to find any evidence of this. A species of *Abelmoschus*, with a blossom and fruit somewhat similar to that of the *Gossypium*, is common in the jungles; but an examination of the locality shows that these plants are not in either blossom or fruit at the present time. The dried seed pods, of which a few were still remaining on the plants, showed no signs of having been tenanted by any borer.

The bolls are also infested by myriads of the small Lygaeid bug—*Oxycarenus lœtus*, Kirby. The irritation of the numerous punctures apparently causes the pods to open prematurely, when the insects swarm into the lint, fouling it with their excreta. After gathering the crop, the insects may be driven out of the lint by spreading it in the sun.

A few examples of Helopeltis (*antonii*) were captured on the foliage of the cotton plants. No damage from this cause was noticeable, and it is possible that the insects were merely resting, having wandered from the neighbouring cacao. But, when confined with some

* Mr. Maxwell Lefroy informs me that, in India, the borer winters in the seed, so it is possible that the pest may have been introduced in this way. But, in that case, the larva must remain quiescent underground, for several months, until the plants have grown up and commenced to fruit. The remedy will be to fumigate the seed before planting.—E. E. G.

young shoots of the cotton plant, they fed freely and their punctures were followed by the ususal discoloration. After confinement for twenty-four hours, the insects died without depositing any eggs in the shoots.

Other insects captured in some numbers upon the cotton plants were *Callicratides rama*, a species of *Eusarcoris*, *Graptostethus servus*, *Geocoris tricolor*, *Lygus biseratensis*, and one or two small Capsids.

Tea seedlings, killed by an 'Eel-worm', have been received from the Haldummulla district. The roots are thickened and corky, and the bark is more or less separated from the woody part by a layer of decayed tissue of an earthy consistency. In parts, the whole of the tissues are decayed, and large cankerous holes appear in other parts. On standing the roots in a vessel of water, a few nematodes emerged; but the plants had been dead and dry for some time, and had been abandoned by most of the worms, which have probably migrated to the neighbouring plants.

This is a distinctly serious pest; but fortunately one of uncommon occurrence. Only two cases have come to my notice within the last ten years. Seedlings from this nursery should on no account be distributed. The plants should be destroyed at once. The soil should be treated with a heavy dressing of either quick-lime or 'Vaporite,' and the ground left fallow for at least nine months. The superintendent of the estate reports that these plants were on the site of a previous nursery in which the same trouble had been noticed. The nature of the disease being misunderstood, manure had been applied before sowing the second lot of seed, Manure has no deterrent effect against eel-worms. In such cases it will be a grave mistake to make a fresh nursery in the same soil. The ground must be left fallow, or planted with something that is not attractive to the nematodes.

MISCELLANEA: CHIEFLY PATHOLOGICAL.

By T. PETCH.

The extension of the Northway system of tapping to estates in other districts has produced a volume of correspondence dealing with the pathological effects which have been observed to follow its application. It by no means follows, however, that the undesirable effects noted are an inevitable consequence of the employment of that system, and it is fairly certain that some of them would have been found to exist after the application of other systems, if they had been looked for.

Several planters have stripped off the bark a few days after it has been pricked, and have found black spots on the cambium, or rather on the wood and bark where the cambium has been killed, round the incision made by the pricker. As far as my observations go, the pricker always makes a black mark, *i.e.*, locally kills the cambium, when it penetrates to the wood, but with the sharp pricker the mark is only small. The larger marks now seen are the natural result of the blunt pricker, both on account of its greater area and the fact that it pushes into the cambium pieces of bark which assist the decay. In this respect the difference between the effects of the two prickers is one of degree; and if the bark can be pricked without injury to the cambium there will be no black spots. What subsequently happens on these spots is shown by a specimen which has been in my possession since 1906. The cambium over the discoloured area is killed, and for a brief period no further growth can take place at that spot. But in a very short time new cambium grows in from the healthy cambium round the spot, and this proceeds to cover the discoloured area with a new growth of wood. At the same time, a new bark is formed underneath the old bark, with the result that the original bark dies and scales off. This leaves a small round scar, surrounded by the slightly upturned edge of the original bark. The process is exactly the same as if a circular patch of bark had been cut out at first; the subsequent healing processes in that case, *i.e.*, the growth of new cambium, wood, and bark from the edges of the wound, follow the same course as in the case of the black spots. The scar which is left in the latter case usually resembles a branch scar, *i.e.*, the scar which forms where a branch has been broken off close to the stem, and its area is roughly equal to that of the underlying black patch. Though the death of the cambium at these spots may make it advisable to cease tapping for a time, there is practically no permanent injury to the tree. The black spots are ultimately buried in the wood and cannot do any further harm. It was suggested that, as the vessels of the wood are destroyed there, they would hinder the flow of water, in the wood, up the tree; but as the patches are extremely thin, and their breadth bears only an infinitely small ratio to the total area of cross section of the tree, this effect is entirely negligible.

The above account is based on the supposition that the original black patches remain distinct. If, on the other hand, each patch spreads to any extent, or if the pricker-cuts into the wood are close together, then the adjacent patches will coalesce, and the subsequent ingrowth of cambium can only arise from the cambium which remains healthy. In these cases the patch of bark which dies off and is cut out will be much larger, corresponding in size, as before, to the underlying black patch, and in extreme cases the tree may be ringed.

These facts bring us in conflict with another of those plausible phrases which have been promulgated and accepted without due consideration, viz., "incision, not excision." In the case where the planter incises and injures the cambium, the tree immediately begins to excise very much more bark than was expected. Even when the cambium is not injured, the tree excises a small cylinder of bark immediately round the incision made by the pricker; these may fall out, and leave the bark pitted, or they may remain *in situ* and constitute so many obstacles to the free flow of the latex. It has been previously pointed out that if the planter "incises," the tree "excises" the tissues round the wound. In the old system of paring and pricking practically all the pricked bark was subsequently scaled off. Further, it is known, that the renewal of bark after paring (*i.e.*, uniform excision) is satisfactory as far as regards the number and arrangement of its latex tubes, while on the other hand we have been warned that this is not the case after pricking (*i.e.*, incision and consequent local excision). The theory of "incision, not excision," however admirable it may appear, fails therefore in practice.

Through the courtesy of the Editor of the *Times of Ceylon*, I have received the two samples of bark referred to in that paper, on May 17th last. One of these was pricked six months previously and the other apparently more recently. Both show that even if the pricker does not actually penetrate to the cambium, its effect is felt there in that the cambium subsequently produces abnormal tissue, and the sample with six months' renewed bark completely confirms the result arrived at by Dr. Fitting, *i.e.*, that the renewed bark beneath the pricker-cut consists of stone cells without latex tubes. Now that the specimens are preserved in alcohol, this difference in structure is clearly indicated to the naked eye. For the tissue built up of stone cells is denser than the normal cortex, and therefore does not contract to such an extent as the latter when placed in alcohol. The tissue underneath each pricker-cut forms, therefore, a small elevation on the inner (cambial) side of the preserved cortex.

Another phenomenon which has caused some alarm is the occurrence of pads of coagulated latex between the wood and the bark surrounding the pricker-cuts. In some cases this will be only an extension of the effect noted above, *i.e.*, the occurrence of black spots in the same situation. The explanations which have been furnished, however, are widely at variance with the known structure and reactions of the Hevea tree. It may be laid down as a general rule, after four years' investigation of the subject, that when the bark decays owing to the attacks of fungi or from other causes, latex does not exude from the decayed tissue. The latex in the vessels is coagulated by the products of decay, or dries up because of the interruption of the water supply. Latex can only exude if the tissues are *suddenly* wounded. For example, the whole of the bark of a Hevea may be killed by *Corticium javanicum* without the appearance of a single globule of rubber on or under the bark. But if any expansion or contraction occurs, either in the diseased tissue or the surrounding healthy bark, then the diseased tissue separates from the wood, and, as it does so, the fracture may extend along the cambium for a short distance into the surrounding healthy tissue, and consequently cause the flow of latex from the latter into the gap between the wood and the diseased bark. It has been claimed that a periodic contraction and expansion occurs daily in a Hevea stem, though the evidence in favour of the contention is scarcely satisfactory; but there is undoubtedly a difference in the tension of the bark cells in the morning and afternoon of a dry day, owing to the removal of water from the latex. This is shown by the greater percentage of rubber in the latex of afternoon tappings than of morning tappings. These differences in tension may be quite sufficient to produce the slight splitting required, though there may be other causes, *e.g.*, direct sunlight; and given the existence of black spots where the organic connection of bark and wood is destroyed, we have all the conditions necessary for the accumulation of pads of rubber underneath the bark. The point ignored in the explanations offered in the local press is that there must be a split

between the bark and the wood before the latex can accumulate there. If, as is contended, the pricker-cut is closed by coagulated latex prematurely, then the latex would remain where it was before pricking, in the latex vessels. It is impossible that it should flow internally into the *solid* tissue.*

The insertion of the metal channelling is a weak point of the Northway system. It would surely be possible to devise some method of building up a channel of clay or some similar material round the base of the tree. It must be remembered, however, that this material must not contain any oil, etc., which would soak into the bark, since if this occurred the tree would be effectually ringed, as happened when Smearoleum was applied. The tar oils (?) in Smearoleum soaked through the bark into the wood and stopped the upward flow of water; consequently many of the trees treated with it died.

LIVE STOCK.

SELECTING LAYING STOCK.

BY H. V. HAWKINS,
Poultry Expert.

(From the *Journal of the Department of Agriculture of Victoria*, Vol. VII., Pt. 2, February 10, 1909.)

There are a great many methods advertised in various pamphlets and papers stating that, if you will practise this or that method of selecting as laid down in the paper, you will be able to determine the drones from the workers. The writer has tried a few of these so-called certainties, and has come to the conclusion the trap nest is the only accurate test. It is by selection and keeping records, that advancement is made along this line.

Each hen has her own individuality, *i.e.*, certain hens lay eggs that are in nine cases out of ten hatchable. Some hens lay well, but, although their eggs are usually fertile, they will not hatch whether set under a hen or placed in the best incubator. The chicks develop to a certain size, in many cases being fully formed, but die in the shell. Again, many hens lay eggs that are seldom fertile.

In selecting birds one has several objects. The saying "that the hen that lays is the hen that pays" is often heard. The majority of those engaged in the poultry business consider egg production the best end of the business. It is often the surest. There is not the same amount of risk attached to it. At the same time, if people are foolish enough to believe that Mr. So-and-So can supply eggs from hens, tested by the so-called new system, which have produced 300 eggs per annum, they have more faith in the advertiser and the hen than the writer has.

There is no doubt that certain characteristics should be looked for in a good laying hen. She should be low set, and stand on a pair of shanks fairly wide apart. The head should be nice and clean cut with a *full* bright eye. In other words, hens should show feminine character and not wrinkled and sunken features. Hens of the latter type should be discarded; in short, masculinity in the hen is a bad sign. A hen with a large capacity for food, *i.e.*, has a large crop (*craw*), is usually a payable bird to feed. The smaller the sack of food she takes to roost at night the fewer eggs will she produce. Dairymen know that a cow must have plenty of room for food in order to produce a large milk yield.

The advertised systems serve one purpose, viz., by examining the lay bones the amateur knows which bird is about to lay, or is laying. Should the lay bones be relaxed to the extent of about three fingers (closed) the bird is laying; if they are almost in contact, that is the hen to market, but so much depends on the time of year one wishes to sell table fowls.

DAIRY-FARMING: WILL IT PAY IN CEYLON?

BY P. GEO. SCHRADER.

(From the *Ceylon Independent*, 22nd January, 1909.)

(*Continued from last issue.*)

BUILDINGS.—I do not believe in sinking a lot of non-interest bearing capital into palatial buildings. I say leave it to the cows to provide for the building of substantial permanent buildings later on—surely it is not asking too much from them, in asking them to provide comfortable houses for themselves and for those that tend and look after their

* Specimens since submitted by the Editor of the "Times" prove that the rubber pads can form before pricking.

welfare. For the start all that is necessary is a comfortable bungalow for the manager, a bungalow to accommodate the overseer and the two responsible milk delivery men, a line for eight men, a milking shed with ten bales, and stabling for four horses, with an unwalled extension for carts and implements; also a large open shed for the cows to camp during wet weather. As the timber will be secured during the clearing, and the roof will be thatch, and the walls of wattle and daub, the cost will not be great. In the course of a few years, certainly, put up good, substantial buildings.

GROWING FOOD.—This is the question of the greatest importance, as on a plentiful and good supply of green food, grass and ensilage depends entirely the success of the farm. It is a well-known fact that dry food—for example, chaff mixed with oats, bran (crushed), maize, etc., does not and will not increase the yield of milk. Bran, oats, maize and oil cake increases the percentage of fat but not the yield. In fact, dry food decreases the yield—if given at all it must be steamed. On the other hand, it is well known that green succulent food of good quality and ensilage greatly increases the yield of milk. It will be noticed that in the first year's working expenses I have included oil cake to the value of Rs. 2,740·50. I did this simply as a safeguard and a stand-by especially for the first year, as the growing capacity of the soil, etc., is not known. The farm, except under exceptional circumstances, must grow all the food it requires, or else most of the profits will go to the supplier of the food. One of the best foods for cows either in the green state or in the form of ensilage is maize—we know that maize grows well in Ceylon. My experience in Australia was that on ordinary good land a crop of 15 to 20 tons of maize can be procured per acre. An average cow requires 50 lbs. of silage or green fodder per day—we have 48 head of stock including horses, stud bull, and working bulls, so it would be advisable to store in the soils food sufficient for them for six months, this means at the rate of 50 lbs. each per day that 150 tons of silage is required. Then, taking the lower estimate of being able to grow 15 tons per acre of maize, it will be necessary to put in ten acres of land under it; but as we do not know the growing capacity of the particular land and to be on the safe side, I would put in twenty acres of land under maize for silage making. For the making of the best silage underground roofed bricked pits are necessary. A pit 15×15 feet holds 50 tons of silage, so we will require three pits of that size to store 150 tons we intend to make. I will not go into the subject of ensilage making, as in a previous article I dealt with it pretty fully; suffice it to say that although the making and use of silage is very little known in Ceylon, that it forms one of the chief factors of dairy farming. For the feeding of the stock for the remaining six months we must grow some green fodder crops and grass. I would put in twenty acres under guinea grass—it grows and thrives splendidly in the low country, and, according to analysis, has proved to be a splendid food for dairy cows; this will be a permanent pasture. For green fodder crops we have the well known varieties of millet known by the Sinhalese as Kurakkan and Sorghum known as Karal-iringu—these two will make excellent green fodder crops as well as silage. The sowing for green fodder has to be done with a certain number of days intervening, so that the whole crop will not be fit for use at the same time, but rather that it can be cut as required for daily feeding. It is very important that the cows should be given a variety of diet—they appreciate and enjoy it just as much as human beings, and the result is more milk. As we did for the silage crops we will devote twenty acres of land for growing Millet and Sorghum. We still have twenty acres left—of course, the buildings with their respective kitchen gardens, etc., will take up an acre or more—all the balance will be required in the future when the stock increases. It is very important that a series of experiments should be tried with other green fodder and grass crops, so that rotation of crops and variety of food could be succesfully carried out. In feeding cows salt must not be forgotten, as it is most necessary for keeping the cows in health. It assists digestion, is good for the milk supply, and is said to prevent worms.

IMPLEMENTS NECESSARY AND APPROXIMATE COST.

	Rs.	c.
2 ploughs ...	198	00
1 set of harrows ...	67	50
3 hand seed drills ...	123	75
1 cultivator ...	49	00
1 roller ...	100	00
1 chaff cutter for silage making ...	115	00
I set horse gear for driving cutter by bullock power...	285	00
Freight ...	100	00
Tools, etc. ...	50	00
	Rs. 1,088	75

WATER FOR COWS.—The importance of providing a plentiful supply of good water for milch cows is one of the secrets of success, and a matter to which very few dairy men give one iota of consideration. The cow should be induced to take all the water she will, and at no time should she be allowed to suffer from thirst. A cow that gives a large supply of milk must be provided with an ample supply of good water, for we must remember that of the constituents of milk about 87 parts are water. Experiments have proved that the quantity of milk had been increased several quarts per day and without affecting the quality. The amount of milk obtained was approximately proportionate to the amount of water drunk. It is of very great importance that the water supplied to cows should be clean and pure. A quantity of the water consumed by the animal is passed into the milking utensil, and if the solids are held in an impure solution, which must be the case if the cow is allowed to drink bad water, we cannot expect pure wholesome milk.

CHOICE OF COWS.—The all-important question—as the best manager and a supply of the best foods and water will not produce a large supply of good milk, unless the cows are by breeding and training a machine to convert food into a plentiful supply of milk—is the choice of suitable cows. I would recommend procuring the cows from Queensland, as it being a semi-tropical country the cows will suit our climate better than cows imported from a cold region. The choice of individual cows is very important, but as it is not possible for anybody from here to do that personally, it would be possible to get the help of the Queensland Agricultural Department, who will no doubt depute the Agricultural College authorities, or their dairy expert, to do their best for us. I suppose the ordinary laymen or even most of those who are interested in dairying little know how much depends on the choice of the best milk breed and the individual choice of the cows for the success of the industry. For Ceylon the best breed would be the Ayrshire or the cross with the Ayrshire bull and any good milking strain. They are strong and healthy and produce a large supply of very rich milk and are known to do well in sub-tropical regions. In choosing a milk cow an experienced dairy man would look for the following points:—Forehead and muzzle broad, face long and clean out, ears fine, horns smooth, neck tapering, forequarters deep, the back and loins level and wide, the legs fairly short with a good amount of bone, the hams allowing plenty of udder room, the frame well rounded, with deep chest; the skin should be soft and pliable, the tail long and the hair fine. But still experience has proved that the points of a cow is not a sufficient guide for the choosing of dairy cattle. Buying cows without knowing their performances is like buying a pig in a bag—you never know what you have got until you open the bag. If we want good results from a horse we look for the performances of his ancestors. Why not do likewise in selecting a cow? Although I have made a study of the points of a cow I would rather have a record than all the points she could carry. Individuality, quality and performance are what we require in all animals for the dairy, and these points can only be determined by placing each cow on her own merits. In Ceylon all that we can do is to get the best cows selected from the best herds and by keeping a record of their performances and retaining the progeny of the best milkers, we will establish a first-class dairy herd of our own.

In conclusion, I must state that there is good money to be made out of the business, but the present modes of running dairies must be altered beyond recognition—for instance, calves must not be allowed to run with their mothers and suck them, they must be removed and kept separately two or three days after birth, and fed with fresh milk drawn from their mothers. The present process of allowing the calves to suck the mothers during and after milking means the waste of a lot of time during milking; means that the calves get the best of the milk as the last stripplings are the richest in fat, and the great loss sustained by not being able to milk a cow at all in case of the death of the calf. The hand feeding of calves has another great advantage, that of making them tame and docile from their very birth. The two-hand system of milking must be insisted on as it is of great importance. Cleanliness in everything must be a speciality. The introduction of delivery horse-cart is of great importance, as it makes possible the delivering of milk from a reasonable distance from the city and also greatly facilitates an early delivery. The two horses and carts that I have estimated for could cover a very big milk delivery round.

This matter is well worth the consideration of capitalists who wish for quick and handsome returns with no great risk.

SCIENTIFIC AGRICULTURE.

THE CAUSE OF INFERTILITY IN SOILS.

By C. DRIEBERG

[Paper read at the Annual General Meeting of the Agricultural Society on June 8, 1909.]

This brief note deals with a subject of the very greatest importance to the agriculturist, and upon which important deliverances have recently been made by two leading schools of scientific thought.

The cause of infertility and the means of maintaining fertility in cultivated land have been matters for great divergence of opinion from the time of de Candolle and Liebig to the present day. Within comparativeiy recent times the purely chemical theory of soil exhaustion has had to be modified so as to admit the all-important influence of bacteria in their relation to the soil and plant. More recent researches in America by Whitney and Cameron have tended towards what may be said to be a reversion to de Caddolle's excretory theory, and the attributing of infertility to an insanitary state of the soil arising from the presence of toxic bodies consisting of plant excreta. The means of maintaining a sanitary condition are said to be aëration provided by proper cultivation, rotation of crops, green manuring, and the judicious use of fertilizers—all of which, according to the American view, act directly or indirectly as correctives or disinfectants, and result in the soil being purged of the poisonous substances which reduce the yield of crops grown continuously on the same land, or cultivated without due regard to the requirements of the soil. The American school goes so far as to deny that soil exhaustion in the chemical sense of the term takes place at all, since all soils contain solutions sufficiently rich in the elements of plant food to nourish a full crop, provided some other factor does not come into play. Humus as an ingredient of soil is looked upon as a sort of "cure-all," giving to it those qualities which make for sanitation and productivity.

The above is a very brief statement of the American theory of infertility in soils.

The British view of the question is that expounded by Hall of Rothamsted. He is not prepared to allow all the determinations claimed by the American scientists, and certainly does not agree with their theory of plant food, and the denial of its exhaustion; but, on the other hand, recognizes the need there is for some fertilizing agents, of which the composition has to be determined more by the soil than the plant, to rectify the deficiencies of the soil as regards the requirements of the crop in question. A knowledge of these requirements can, we are told, only be decided by experiment, with a view to ascertaining the "idiosyncracies" of plants which are sometimes somewhat paradoxical (note the attitude of wheat and swedes towards phosphoric acid.

The best notion of fertility, according to Hall, is got by extending Liebig's "law of minimum" to all factors affecting yield—plant food, temperature, soil texture, water supply, &c.

Hall finds fundamental difficulties in accepting the poison theory. In fact, he doubts whether the toxins extracted by Whitney were really excreted by the roots, and whether they are really toxic in the soil because they were found so in dealing with seedlings and through water culture. He instances the case of ammonia under similar conditions.

Experience in the continuous and successful cultivation of wheat at Rothamsted for fifty years with proper cultivation and fertilizing, in his opinion, negatives the excretory theory.

He is prepared to admit that there is such a thing as the "sickness" of land which is kept continuously under one crop, and further that most crops (some specially so) effect changes in the soil which unfit it for the continued growth of the crop. This injurious factor may be the excreted toxins of the American theory or some "secondary effects due to the competition of injurious products of bacteria and other micro-flora" in the soil. If we assume that there is some kind of "debris" (not of the nature of excreta) left by the plant as the result of bacterial action upon it, we may, he thinks, ultimately obtain a clue to certain phenomena at present imperfectly understood.

The value of a rotation is readily admitted, but its beneficial effects are attributed mainly to good tillage and the clearing away of weeds, insects and fungoid pests, though, it is thought, there may possibly also be certain beneficial effects beyond these. It is also admitted as possible that there is a clue in "disinfection" of some kind, as indicated by the increase of fertility which follows

partial sterilization of the soil such as can be produced by heat or the use of certain volatile antiseptics.

The following remark of Hall indicates how much there is yet to learn regarding the questions of fertility and infertility, and how far we still are from being able to control the soil:—"The soil is such a complex medium—the seat of so many and divers interactions, chemical, physical, and biological—and is so unsusceptible of synthetic reproduction from known materials, that experimental work of a crucial character becomes extremely difficult, and above all requires to be interpreted with extreme caution and conservatism."

There is here evidently intended a gentle reprimand to the American scientists for propounding theories which must be considered "not proven;" and yet it is evident that Hall himself is travelling along the same line of thought though his caution will not permit him to dogmatize.

The conclusion of the whole matter, from an agricultural point of view, emphasizes the necessity for specific knowledge of the habits of cultivated plants, and (to use Hall's expression) their "idiosyncracies"—knowledge only to be derived through experiment and experience.

FERTILIZER ACTION.

(From the *Journal of the Board of Agriculture, British Guiana.* Vol. II., No. 3, January, 1909.)

Mr. A. D. Hall, of the famous Rothamsted Experiment Station, which for over half a century has been the scene—as it was the pioneer—of continuous agricultural experiments on an agricultural scale, contributes to the American Journal "Science," of November 6th, an important and most informing paper on "Theories of Manure and Fertilizer Action" which was read by him as a lecture at the Graduate School of Agriculture, Cornel University, in July, 1908. While summing up the present state of knowledge on this vital matter, the English expert finds occasion to criticise adversely the new and revolutionary theory, recently advanced by Messrs. Whitney and Cameron, that the beneficent action of fertilizers is really due to their destructive effect on the toxins or poison excreted by the roots of plants in the soil (which it is alleged tend to accumulate to a harmful degree if the same crop is continuously grown on the same plot of land) and not to their modifying influence on the quantity and quality of the plant-food. The paper is too long for reproduction here, and a brief summary only can be given; but this may serve to draw attention to a valuable contribution to the science of Agriculture.

Commencing, as is natural, with Liebig, Mr. Hall neatly re-states the German chemist's theory of the action of manures thus:—"The proper fertilizer for any particular crop must contain the amounts of nitrogen, phosphoric acid, potash, and other constituents which are withdrawn from the soil by a typical good yield of the plant in question," and proceeds to show from Rothamsted experiments on wheat, barley and swede turnips that the theory is inadequate to explain the results observed. Thus wheat and barley though taking identical amounts of phosphoric acid from the soil are quite differently affected by phosphoric acid as a fertilizer; the effect on the former being of quite secondary importance, but in the latter comparing with that of the all-essential nitrogen. For both plants the addition of potash counts for little or nothing, although wheat withdraws 29 lbs. of that constituent from each acre of soil, and barley 56 lbs. Evidently the soil is able to supply all the requirements of the plant for potash in spite of the large amounts which the crop removes; and it is here, as Mr. Hall says, that Liebig's theory fails—it takes no account of the soil and the enormous accumulation of plant-food therein contained. "A still more noteworthy example is provided by the swede turnip crop; the analysis of a representative yield would show it to withdraw from the soil about 150 lbs. per acre of nitrogen, 30 lbs. of phosphoric acid, and 120 lbs. of potash. Yet the ordinary fertilizer for the swede crop will consist in the main of phosphatic material with but a small quantity of nitrogen and rarely or never any potash. These differences in manurial requirements are, as the lecturer points out, correlated with the habits of growth of the plants. The wheat possesses a very extensive root system and a long period of growth, hence it is specially well fitted to obtain whatever mineral constituents may be available in the soil; barley is a spring sown crop, but being shallow-rooted and having only a short growing season, the plant experiences a difficulty in satisfying its requirements for phosphoric acid; the swede is sown late in the season after a very thorough preparation of the soil, so that the nitrification alone of the nitrogenous residue in the soil is capable of furnishing almost all the large amount of

nitrogen it requires, but it is very shallow-rooted and must be supplied with an abundance of phosphoric acid."

A COMPLEX SUBJECT.

Yet this explanation does not begin to exhaust the possibilities of what is an extremely complex subject. "Many plants do not exhibit such idiosyncrasies as are shown by wheat and swedes, but require a general fertilizer, the composition of which is determined more by the soil than the plant. Indeed, no theory of manuring can be based upon the plant alone, but must also take the soil into account, so that a fertilizer may be regarded as rectifying the deficiencies of the soil as far as regards the requirements of the crop in question. What those special requirements are can only be decided by experiment. Mr. Hall comes to the conclusion that the best general point of view of the action of fertilizer is, perhaps, obtained by extending the "law of the minimum" originally ennunciated by Liebig (according to which the yield of a given crop will be limited by the amount of the one particular soil constituent which may happen to be deficient) and extending it to "all the factors affecting the yield as well as to the supply of plant-food, *e.g.*, to such matters as the supply of water, the temperature, the texture of the soil. On poor soils the water supply is very often the limiting factor, on very open soils because the water actually drains away, on extra close soils because the root range is so restricted that the plant has but little water at hand, and the movements of soil water to renew the supply are very slow; in either case the plant will be sure to have as much nutriment as is required for the small growth permitted by the water present. It is only when the water supply is sufficient that the resources of the soil as regards all or any of the constituents of a fertilizer are tested, and may become in their turn the limiting factors in the growth of the crop. Hence it follows that fertilizers may often be wasted on poor land where growth is limited by the texture of the soil, by the water supply or some other factor." Points are made by the lecturer of the huge amount of plant-food actually present "though in a highly soluble condition," in soils—"The soil of the manured plot on the Rothamsted wheat field contained in 1893, after 54 years' cropping without fertilizer, 2,570 lbs. per acre of nitrogen, 2,950 lbs. of phosphoric acid, and 5,700 lbs. of potash"—and of "the law of diminishing returns" by which the first expenditure of fertilizer or other factor of improvement is the most effective, each succeeding application producing smaller and smaller returns, until a further addition causes no increase in the yield; and a remarkable proof is given of the direction of the movement of soluble salts in the soil. It appears that in the soil all reactions are extremely localized, since they take place in the thin film of water normally surrounding the soil particles, in which movement of the dissolved matter takes place very slowly and mainly by diffusion. At Rothamsted two grass plots have received for 52 years in succession very large amounts of soluble fertilizer (in the one case 550 lbs. per acre of nitrate of soda and in the other 600 lbs. per acre of ammonia salts), and though these plots are separated only by an imaginary line from others receiving either no fertilizer or characteristically different one, the distinction remains perfectly sharp "and the rank herbage produced by the excess of nitrogenous fertilizer on one side does not stray six inches over the boundary." A test of the soil to a depth of seven feet (in 1893) in the Rothamsted wheat field—in which the fertilized plots are separated from each other by unfertilized strips only 12 inches in breath—showed clearly that the amount of nitrates found "was in each case characteristic of the supply of nitrogen to the surface of the plot, and right down to the lowest depth there were no signs of the proportions approximating to a common level as they would have done had any considerable amount of lateral diffusion taken place." As the treatment has been continued in all cases for at least 40, and in some instances for 50 years, Mr. Hall seems justified in his conclusions that the evidence indicates that "the movement of the soluble salts in the soil are confined to up-and-down motions due to percolation and capillary uplift, and take place laterally only to an insignificant extent."

THE "POISON" THEORY.

Having come to these general conclusions, Mr. Hall proceeds to consider Messrs. Whitney and Cameron's theory of the action of fertilizers. This would appear to be inspired by a real difficulty—indeed, the Rothamsted expert admits it to be "fundamental"—which may be illustrated by the behaviour of phosphoric acid when applied as a manure. It is a fact that a soil may contain enormous quantities of plant-food and yet be by no means notably fertile—for instance, 2,500 lbs. per acre of phosphoric acid may be present, and yet swedes will not do well unless supplied with an additional dressing of 50 lbs, per acre of soluble phosphoric acid—and "it is usually assumed that the effect of

this phosphoric acid manuring is due to the soluble nature of the fertilizer, because of which the additional plant-food is directly available for the crop." A study of the re-action in the soil, however, shows that this theory is insufficient; the soluble phosphoric acid is very rapidly precipitated in the soil, and remains so close to the surface that it is never washed out in the drains. Upon such facts as these, Messrs. Whitney and Cameron argue that "the concentration of the soil water for a given plant-food, such as phosphoric acid, must be approximately constant for all soils of the same type, however much or little phosphatic fertilizer may have been applied, and since water culture experiments show that this low limit of concentration attained by the soil water is more than sufficient for the needs of the plant, no soil can be regarded as deficient in this or any other element of plant-food. It therefore follows that the action, if any, of a fertilizer must be due to some other cause than the direct supply of plant-food, with which the soil water must always be saturated to a degree which is quite unaffected by the supply of fertilizer;" and following up this conclusion they suggest this theory of fertilizer action:—"A soil falls off in fertility and ceases to yield normal crops, not because of any lack of plant-food brought about by the continuous withdrawal of the original stock from the soil, but because of the assimilation of injurious substances excreted from the plant itself. These toxins are specific to each plant, but are gradually removed from the soil by processes of decay, so that if a proper rotation of crops is practised, its yield will be maintained without the intervention of fertilizers. The function of fertilizers is to precipitate or put out of action these toxins rather than to feed the plant."

Mr. Hall's criticism of both theory and arguments cannot be considered as anything less than destructive. He declares that Messrs. Whitney and Cameron's views cannot have any bearing whatever on the amount of nitrates in the soil water "since they come into a dissolved state as fast as the nitrifying bacteria produce them, and are not in equilibrium with any store of undissolved nitrates in the background. As regards phosphoric acid the theory assumes such as excess of bases that all soils behave alike and immediately precipitate the phosphoric acid in practically the same form; while as regards potash the argument seems to forget that though the addition of a soluble potassium salt may throw some of the other sparingly soluble potassium compounds out of solution, the total amount of potassium remaining in solution is still greatly increased. The function of the carbonic acid in the soil water is ignored, as again the fact that the processes of solution in the soil must be in a constant state of change." The crucial test by analysis of the soil water fails, so far as Rothamsted is concerned, for "When the Rothamsted soils, with their long-continued difference in fertilizer treatment, are extracted with water charged with carbon dioxide, the nearest laboratory equivalent to the actual soil water, the amount of phosphoric acid going into solution is closely proportional to the previous fertilizer supply." The new theory also supposes that the plant itself exerts no solvent action; but besides Sachs' famous "etching" experiment, an ingenious device by Kossowitsch seems to prove conclusively that roots have a preponderating influence on the assimilation of phosphoric acid at any rate. "The only factor determining the supply of phosphoric acid and the consequent difference in growth," says Mr. Hall in quoting this experiment, "was the solvent action of the roots where they were actually in contact with the calcium phosphate, and this solvent action . . . . . may most probably be attributed to the carbon dioxide secreted by the roots."

NOT PROVEN.

With regard to the "toxin" part of the theory, Mr. Hall has some pertinent comments to make. He doubts whether the alleged toxins extracted from the soil by Whitney are really excreted by the roots of the plants and whether they are really toxic in the soil merely because they have been proved so in water cultures. "A body like ammonia, itself a product of protein decay and present in the soil, is exceedingly toxic to water cultures, yet when applied to the soil it increases the growth of the plant." Particularly is it the specific action of fertilizers that is so difficult to explain on this hypothesis. "Why," he asks, "should substances so dissimilar as nitrate of soda and sulphate of ammonia exert the same sort of action on the same toxin? Why should phosphates cause all classes of plants to develop in one direction, or why should it be appropriate to the toxins of all plants on one particular type of soil, whereas potash answers on another type? Lastly, there is a lack of evidence for the fundamental thesis that the rotation will take the place of fertilizers, and that the yield only falls off when a particular crop is grown continuously on the same land." This

last he proves from the Rothamsted experiments which have shown "that wheat can be grown continuously upon the same land for more than fifty years, and that the yield when proper fertilizers are applied remains as large in the later as in the earlier years of the series. . . . Mangolds. . . . show no falling off in yield though they have now been grown upon the same land for thirty-two years."

Nevertheless the "sickness" of land continuously under one crop is a fact which the Rothamsted experiments undoubtedly confirm, and Mr. Hall is prompt to admit it. There is some positive evidence that "most plants—some to a very slight degree, like wheat, and mangolds, others markedly, like clover, turnips and flax—effect some change in the soil which unfits it for the renewed growth of the crop," and this injurious factor may be, Mr. Hall thinks, "either the excreted toxins of Whitney's theory or may be some secondary effects due to the competition of injurious products of the bacteria and other microflora accumulating in the particular soil layer in which the roots of the crop chiefly reside." But "as it stands at present Whitney's theory must be regarded as lacking the necessary experimental foundation, no convincing evidence has been produced of the fundamental fact of the excretion of toxic substances from plants beyond the autotrophic seedling stage, nor is there direct proof of the initial supposition that all soils give rise to soil solutions sufficiently rich in the elements of plant food to nourish a full crop did not some other factor come into play."

"If, however, we give the theory a wider form, and, instead of excretions from the plant, understand débris of any kind left behind by the plant and the results of bacterial action upon it, we may thereby obtain a clue to certain phenomena at present imperfectly understood. The value of a rotation of crops is undoubted, and in the main is explicable by the opportunity it affords of cleaning the ground, the freedom from any accumulation of weeds, insect or fungoid pests associated with a particular crop, and to the successive tillage of different layers of the soil, but for many crops there remains a certain beneficial effect from a rotation beyond the factors enumerated." That the clue lies in "disinfection" of some kind would seem to be indicated by Mr. Hall; who in his closing remarks draws attention to the increase of fertility which follows partial sterilization of the soil either by heating or by the use of volatile antiseptics such as toluene or carbon bisulphide. But he concludes with a warning which may well be taken as a "word to the wise." "The soil," he says finally, "is such a complex medium—the seat of so many and diverse interactions, chemical, physical and biological—and is so unsusceptible of synthetic reproduction from known materials, that experimental work of a crucial character becomes extremely difficult, and above all required to be interpreted with extreme caution and conservatism."

MISCELLANEOUS.

LITERATURE OF ECONOMIC BOTANY AND AGRICULTURE.

BY J. C. WILLIS.

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HEREDITY. II.

BY R. H. LOCK.

In our first paper on this subject published in the *Tropical Agriculturist* for June, 1909, an attempt was made to explain the method by which simple unit characters are passed on from parents to their offspring. We have now to show how, by the application of this knowledge, a number of problems, which have baffled students of breeding for many centuries, are capable of a reasonable and comparatively simple explanation.

It may be well to summarise briefly the points which are now to be taken as understood,

Supposing by any possiblity two parents were to breed together whose hereditary endowments were in every respect identical—the parents being alike not only externally, but in all the inward essentials of their nature—we should expect the offspring to be exactly like the parents except for such points as might be modified by differences of education and external conditions.

As a rule, however, the two parents are not alike, and the student of heredity is concerned with the problem of how those points or characteristics in which the parents differ, are passed on to future generations.

We are usually concerned with a pair of simple alternatives. To take an extreme case, one parent may be black and the other parent may be white.

In such a case we suppose that the black parent has something in it—a black factor—which causes it to appear black, whilst the white parent contains a white factor.

The offspring of such a pair will contain both factors, black and white—and its appearance will depend upon the relative power of the two factors. In many cases the black factor completely overpowers the white, and the mating results in the appearance of exclusively black offspring. Although the white factor is present, it is invisible.

In the reproductive elements of these last individuals, the black and white factors separate completely. There are produced pure "black" reproductive cells and pure "white" ones in approximately equal numbers.

When two such individuals are mated together, therefore, the offspring may arise either from

a black male cell meeting a	black female cell		
black	,,	,, white	,,
white	,,	,, black	,,
or a white	,,	,, white female cell	

In consequence of this there will appear on the average one pure black individual, one which is pure white, and two which contain both factors just as their cross bred parents did.

A pure black individual is one which will breed true to its proper character when mated with a similar individual; and the same thing holds good in the case of a pure white individual.

A factor which is able, like the black one, to overpower its rival, so that any individual which contains it shows the black character externally, is known as "dominant"; whilst a character like the white one which may be present though invisible is called "recessive."

We have yet to consider what happens when parents are mated which differ in more than one pair of factors. It will be convenient to designate these factors by letters. B and b are the two alternative factors of one pair; A and a those of another. Suppose a parent bearing the two dominant factors A B is mated with one bearing the two recessive factors a b. Suppose we are concerned with a species of plants in which A represents the character redness and B blueness of the flowers, whilst a and b represent the absence of colours respectively. Then A B will have both the red and the blue character and will appear purple, and a b will be white.

The offspring of the cross will also have purple flowers AB ab.

The cross bred plant produces the following different kinds of reproductive cells AB, Ab, aB, ab. According to the rule explained in a previous paper, half

the reproductive cells contain A and the other half a. Furthermore half the reproductive cells bear B and half b. And the characters of the original parents do not stick together when the reproductive cells are formed, but segregate completely, so that the new combinations Ab and aB are formed just as readily as the old ones AB and ab; and all these four sorts of reproductive cells are produced in equal numbers. In self-fertilisation—a process common in plants—the four kinds of reproductive cells meet at random, and the different combinations which they form are shown in the accompanying diagram —

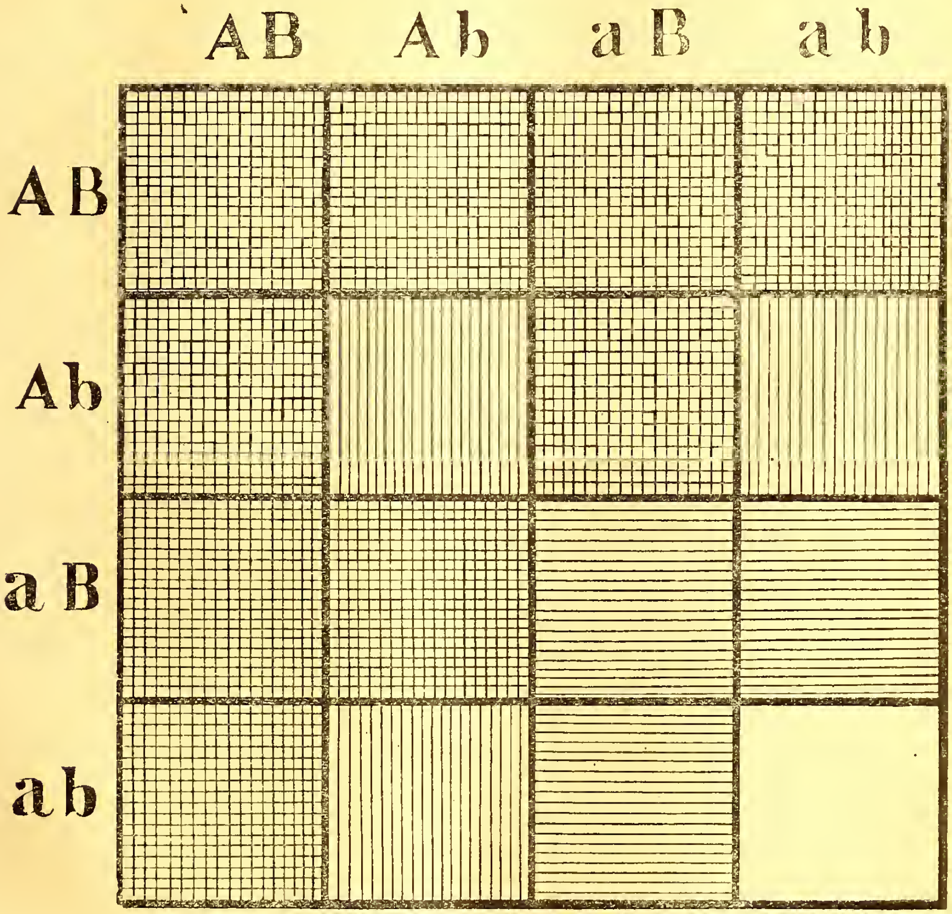

FIG. 1.

In this diagram each square represents an individual plant. The constitution of each individual on the female side is written above it, whilst the nature of the male element which entered into its formation is written on the left-hand side.

Cross-hatched squares represent individuals with purple flowers, vertical shading indicates red flowers, and horizontal shading blue. It will be seen that all purple flowered individuals contain both the elements A and B. Red-flowered plants contain A and not B, whilst blues contain B and not A. One individuals out of sixteen contains neither A nor B and has white flowers.

It will readily be seen that the proportion in which the coloured individuals occur is 9 purple : 3 red : 3 blue : 1 white.

In actual practice when a very large number of individuals is grown the proportionate numbers found will approximate closely to some multiple of the above.

The most remarkable feature of this result is that in this second generation we get two apparently new forms, red and blue, in addition to the purple and white types with which we started. Really these novelties are only new combinations. The original purple was a combination of red and blue; and the white was the combination of "absence of red" with "absence of blue," if the use of such expressions may be permitted. In the rearrangement which takes place at the formation of the reproductive cells of the cross bred, we get the new combinations red with absence of blue and blue with absence of red. When a pair of reproductive cells, each member of which bears one of these particular combinations, unite, the flowers of the resulting plant are either red or blue as the case may be.

No one can fail to recognise that the possibility of thus obtaining new combinations of characters at will is of the very greatest importance in horticulture and stock raising—in the breeding of new varieties of plants and animals. If we find in distinct strains different useful features not common to both, we can very often take, as it were, one character from one and a second character from the other and combine them together by cross breeding. What is more, by selecting the proper individuals of the second generation, we can at once obtain a strain which will breed true to the new combination of characters. It is hardly an exaggeration to say that we can now deal with separate useful characters as if they were the different useful ingredients of a pudding. We can take one useful quality from one variety of wheat for example, and combine it with other useful qualities taken from other varieties. This has actually been done on a considerable scale by Professor Biffen on the experimental farm of the Cambridge University Department of Agriculture.

One part especially of Professor Biffen's work upon wheats calls for particular notice on account of its great theoretical and practical importance. This relates to his discovery of the manner of inheritance of immunity to certain diseases. Biffen found that some strains of wheat suffered terribly on his plots from the attacks of the fungus disease known as yellow rust; other strains grown side by side with the first proved to be perfectly indifferent to this enemy. Biffen crossed a diseased strain with a resistent one. Next year he found that the offspring of the cross were all badly diseased. There is no doubt that any breeder without the special knowledge possessed by the Professor would under these circumstances immediately have given up the experiment as having failed of its purpose, which was the production of an immune strain. Biffen was not in the least discouraged but raised a second generation from the seeds of the diseased plants. Next season the rows exhibited a very remarkable appearance. Among a majority of brown and rusted plants the minority stood out bright and green and were entirely free from the pest. When the plants were counted over at harvest it was found that the proportion of diseased to resistent plants was very nearly 3 : 1. Susceptibility and immunity are in fact a pair of characters exactly comparable with our case of blackness and whiteness, and the immune plants obtained in the second generation constituted a pure resistent strain. More than this, the original immune strain was one of little value to the farmer, whilst the susceptible plant with which it was crossed was of excellent quality in other respects. Among the immune plants of the second generation were found some which combined the character of resistance to disease with the good quality of the susceptible parent, precisely as was to be expected from our rule of the inheritance of two pairs of characters.

Many facts which have long presented an insoluble puzzle to practical breeders and students of evolution alike, meet with a ready and simple explanation in terms of this conception of separately heritable factors. We need only refer to the facts of reversion or throwing back to a more or less remote ancestor.

It is well known that when a pair of pigeons belonging to two distinct breeds are mated together, the result is often a blue bird more or less closely resembling the wild rock pigeon from which all our modern stocks of fancy pigeons are supposed to be descended. The offspring of such a cross are said to revert to the ancestral type.

The simple reappearance of the recessive character in the second generation from a cross in the manner just described, may be called a kind of reversion, but the reversion is only to a very near ancestor, in this case a grandparent. Where a very remote ancestral character makes its appearance we require a different explanation. Here again it will be simplest to take a definite example—the one selected is from Professor Bateson's work with sweet peas.

There seems to be very little doubt that the original type of the cultivated sweet pea was the purple. And the

earliest sports from this were the pure white form and the variety known as painted lady—with a red standard and white wings. Subsequently an enormous number of other colours have been produced. In one of his experiments Professor Bateson crossed together two sweet peas with perfectly white flowers, and from the cross he raised plants with purple flowers—not a conjuring trick but a case of reversion. The next step was to sow the self-fertilised seed of the coloured cross-bred plants to produce a second generation. In this generation a very large number of plants was raised, some with white and some with coloured flowers, and it was found that the proportion of coloured to white-flowered plants was 9 : 7. The explanation is given in the diagram below which shows the composition of the second generation. The

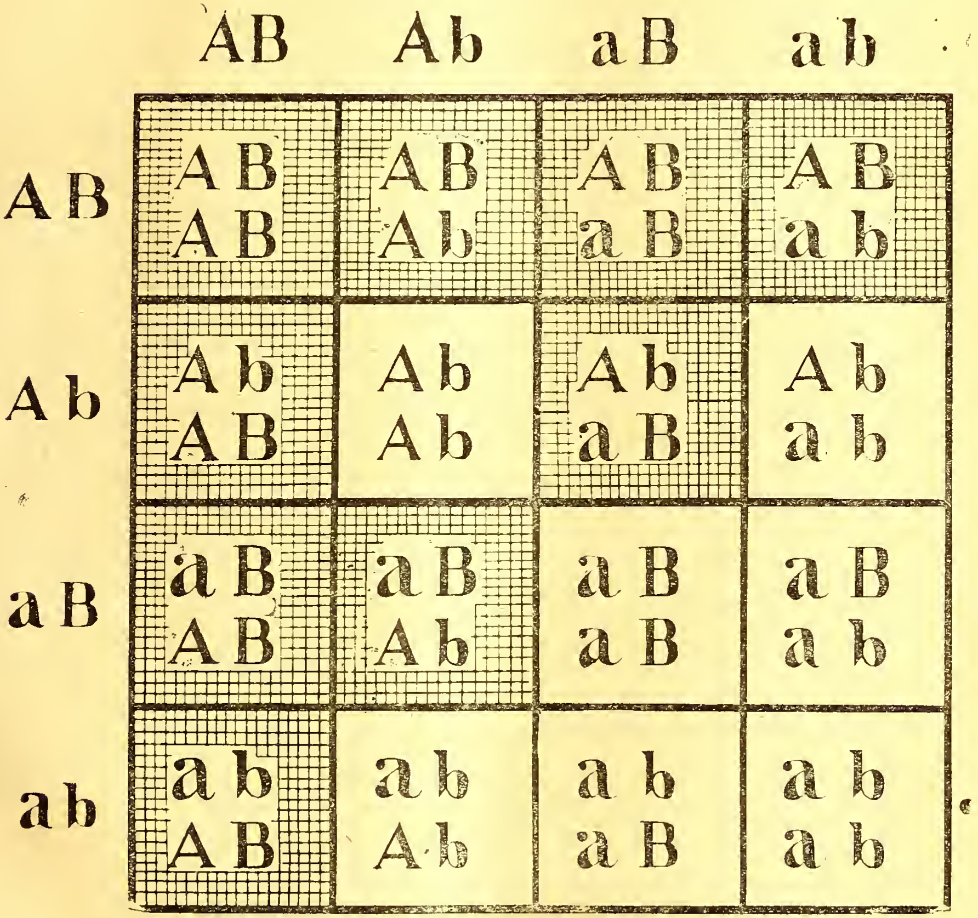

FIG. 2.

secret is as follows. The appearance of any colour depends upon the simultaneous presence of two factors A and B. If either of these factors is absent from a plant its flowers appear white. Thus Ab and aB are both white. The two original parents are supposed to have been of this nature, from one of the two necessary factors for colour was wanting, and from the other the second factor was wanting. But when these two were crossed together, the cross bred ABab contained both factors, and the purple colour at once became visible. The further history of the case may readily be traced from the diagram, refering if necessary to the description of the inheritance of two pairs of characters already given at the beginning of the present article. We must suppose that originally white forms arose from the coloured by two distinct processes of sporting. In one of these the A factor was lost and in the other the

B factor. Here then we have a perfectly simple explanation provided for the phenomenon of reversion. Although we may hesitate to suggest that the same sort of thing is going on when baby's nose unexpectedly resembles the striking portarit of his great-great-grandfather, it is at least quite possible that this may be the case.

We have indeed no grounds for excluding man from the operation of these rules of inheritance. In fact, in the case of one or two simple characters inheritance of this kind has already been demonstrated in human beings.

Those who are only familiar with what was known of the laws of heredity ten years ago, will be struck with a sense of the complete novelty of the ideas here inculcated. The somewhat vague notions current only so short a time since are not so much extended or even altered as replaced by an entirely new set of ideas. And in passing it may be remarked that the biologists of fifty years ago and more were much closer to our present line of inquiry than their successors were.

These new conceptions may be briefly summarised.

We have in the first place the conception of unit characters. We find that separate features of an organism may be inherited quite independently of one another. It is this fact alone which renders experimental work upon heredity possible.

Characters of this kind we find to be inherited according to a definite arithmetical scheme or law, in which, as a general rule, each character pursues its own course unaffected by any other characters which may happen to be present. We do in some cases find so called correlations where groups of features behave more or less as if they were single characters, but into these complications we do not propose to enter on the present occasion.

We find our conception of what constitutes purity in a strain of animals or plants to be completely altered. We now know that purity does not depend simply upon the number of generations during which the race has exhibited a constant character. On the contrary a strain of perfect purity may arise from the second generation from a cross. Such a strain may exhibit an entirely new combination of the parental characters. But this is so far the only kind of novelty which we can produce at will. We know next to nothing about the method by which genuinely new characters arise, as they sometimes do. We can only take advantage of such characters when they do happen to make their appearance.

Special attention should be drawn to the definiteness of the characters with which we deal. We do not invoke improved features by gradual selection; these characters are either present or they are absent. It is further to be remembered that every process of definite inheritance which has been worked out in the case of a plant can be paralleled by similar phenomena taking place in one or other of the higher animals and *vice versa*; heredity in animals and plants seems to follow precisely similar lines.

R. H. L.

CEYLON AGRICULTURAL SOCIETY.

REPORT, 1908-1909.

MEETINGS.

The last Annual General Meeting was held on June 15, 1908. The present report deals with the ensuing twelve months since that date.

At the suggestion of His Excellency the President rule 3 was amended to provide for ordinary Board Meetings being held every other month instead of monthly. Accordingly meetings were held on August 3, October 5, December 3, 1008, and February 4 and April 7, 1909. His Excellency presided at all the meetings.

MEMBERS.

The total numer of members at date is 984, an advance of 70 over last year's number. Actually 110 new members joined the Society, but 40 names had to be removed from the list for various reasons.

The Society has lost a valuable member, who rendered it much service that did not come to public notice, by the lamented death of the Hon. Mr. Nicolle.

CHANGES.

The place of Mr. H. T. S. Ward, who retired from the service of the Colony, has been taken by Mr. R. W. Smith. The temporary vacancy created by Mr. F. Beven's absence in England is being filled by the Hon. Mr. Jas. van Langenberg. In the North-Central Province Mr. Simon Dabre has displaced Mr. Sampander; in the Southern Province Mr. V. S. Wickremanayake has been appointed to represent Tangalla. Dr. Willis went on leave in April last, and Mr. R. H. Lock is acting for him as Organizing Vice-President and Editor of the "Tropical Agriculturist and Magazine of the Ceylon Agricultural Society."

INSPECTIONS.

The Organizing Vice-President and the Secretary, severally and together,

toured in different parts of the Island, inspecting gardens, attending meetings of Branch Societies, visiting Shows, and generally studying the condition and requirements of rural agriculture. The districts visited included Jaffna, Puttalam, Chilaw, Kegalla, Kurunegala, Kandy, Nuwara Eliya, Kalutara, Anuradhapura, and Matara.

AGRICULTURAL INSTRUCTORS.

Three additional Instructors were appointed, bringing up the total number to five : three are available for the Sinhalese districts and two for the Tamil districts. These officers are at present stationed at the under-mentioned centres so as to enable them to conveniently reach all parts of the Island. Mr. S. Chelliah at Jaffna, Mr. S. R. Breckenridge at Batticaloa, Mr. Walter Molegoda at Kandy, and Messrs. N. Wickremeratne and L. A. D. Silva at Colombo.

Messrs. L. A. D. Silva, Chelliah, and Breckenridge are passed men from the late School of Agriculture ; the rest have undergone training at Peradeniya and at the Government Stock Garden.

Already these officers have made detailed tours, traversing some of the remotest parts of the Island which needed their presence and assistance most. As a result a good deal of useful information as to the condition and requirements of these areas has been made available, and a way opened to localities which would not otherwise have been reached by the Society. Their duties have been greatly facilitated by the co-operation of the Government Agents working through the chief headmen.

I would like to say a word in commendation of Messrs. Chelliah and Wickremaratne, who possess initiative and enthusiasm, qualities which should enable them to serve the Society well.

More instructors are needed, but additions to the present staff will probably have to await the opening, it is to be hoped in the near future, of a school for training such officers.

EXPERIMENTAL GARDENS.

Of these gardens, the one at Bandaragama is perhaps doing the most systematic work. It was started under the auspices of the Rayigam Korale Branch, and owes its success chiefly to the personal interest of Mr. Conroy, Assistant Government Agent of Kalutara, and the zeal of Mr. Wirasinghe, the Mudaliyar of the korale.

The newly-formed Pasdun Korale Branch, established through the enterprise of Mr. F. D. Samarasinghe, Mudaliyar of Pasdun Korale East, has laid the foundation of three gardens at Bellana, Agalawatte, and Warakagoda.

Arrangements for starting gardens at Jaffna and Anuradhapura, to be worked directly under the Agricultural Instructor stationed in the Northern Province, are now under consideration.

I may here mention that Mr. Wickremaratne, Mudaliyar of Weligam korale, has done much to encourage the cultivation of fruits in the South through his own garden at Tellijjawila, the Dampella girls' school, and a number of smaller village plantations belonging to his headmen.

I regret to say that nothing could have been done with regard to the proposed garden at Horetuduwa (for which the late Sri Chandrasekera Mudaliyar donated a sum of Rs. 2,500) owing to difficulties that have arisen over the transfer of the site selected for it.

SHOWS.

Shows were held at the following centres :—Hikkaduwa, Mannar, Balalla, Pilessa, Kuliyapitiya, Anuradhapura, Welimada.

The tendency to multiply small shows in village centres is a departure in the right direction. Such shows appeal to the cultivator with greater force than large town shows, which, however, have their own value. This was quite apparent at the three village shows at Balalla, Pilessa, and Kuliyapitiya, successfully and economically worked by Mr. G. S. Saxton, Government Agent of the North-Western Province. Mr. Horsburgh's show at Anuradhapura and Mr. Stevenson's at Mannar also demonstrated the utility of village shows.

Ceylon's chief agricultural products were, on the invitation of the Indian authorities, represented at the Mysore and Nagpur Exhibitions held last year.

REGULAR PUBLICATIONS.

The English, Sinhalese, and Tamil monthly magazines published by the Society were issued regularly throughout the year. The arrangements for their publication remain the same. The proportion of original matter in the English periodical ("Tropical Agriculturist and Magazine of the Ceylon Agricultural Society") has been recently increased. By exchange the Society receives a large mass of agricultural literature in the shape of periodicals, reports, &c., from abroad.

The Sinhalese Magazine ("Govikam Sangarawa"), which completes its fourth volume in June, and has a circulation of 1,400, is a valuable medium of communication and instruction as far as the native cultivator is concerned. It finds its way into the hands of every Government teacher and many teachers of

aided schools, and, through them, reaches a large proportion of the school-going population. It is to be regretted, however, that it does not, as it should, reach every headman in the Sinhalese districts to whom it is available at the almost nominal rate of 50 cents per annum. The Society would do well to allow an increased vote for illustrating and otherwise improving this publication.

The Tamil magazine ("Kamat Tholil Valakkam" is, I am sorry to say, very badly patronized.

OCCASIONAL PUBLICATIONS.

Leaflets dealing with the following subjects published in English, Sinhalese, and Tamil were issued from time to time:—Transplanting and Manuring in Paddy Cultivation; Tobacco Cultivation, Disease, and Treatment; Cultivation and Preparation of Arrowroot; Further notes on Transplanting Paddy; Continuous Cultivation of Chena land; Rice Bug or Paddy Fly; Nitrogen-gathering crops; the Silk Cotton Tree.

In addition, Agricultural Calendars were published in English and Sinhalese.

SUBJECTS DISCUSSED BEFORE THE BOARD.

The following list indicates the subjects of papers, lectures, and discussions that came before the Board at its regular meetings, together with the names of the authors, lecturers, or leaders in each case:—

Recent researches into the cause of infertility in Soils (C. Driberg).

Castration of Cattle (G. W. Sturgess).

Possibilities before the Agricultural Society: its Board and Branch Associations (the Hon. Mr. J. Ferguson).

Improvement in cultivation, and the curing of tobacco for foreign markets (Dr. J. C. Willis).

Introduction of Agricultural Instruction into the curriculum of Rural Schools (the Hon. Mr. Obeyesekere).

Plant Breeding and Tropical Agriculture (R. H. Lock).

Alkali Soils and Water-logging in Irrigated Lands (R. W. Smith).

Beautiful Tropical Trees and their uses (H. F. Macmillan).

The Village Cultivator and Paddy Cultivation (A. Dissanaike).

Vermin Destruction (F. West).

Cassava cultivation as a Local Industry (Dr. Willis).

Native Agriculture, and how it might be improved (W. A. de Silva).

Loans to Paddy Cultivators (A. Dissanaike).

Recent researches regarding the germination of the Coconut and its Products (C. Drieberg).

Relation of weather to crop in the Coconut Palm (J. D. Vanderstraaten).

Cotton cultivation in Kurunegala District (Dr. H. M. Fernando).

Agriculture in Ceylon and its improvement (Dr. Willis).

Loans to Native Agriculturists (Dr. Willis).

Agriculture in the North-Central Province (Dr. Willis).

DISTRIBUTION AND EXCHANGES OF SEEDS AND PLANTS.

A considerable amount of work was done in the distribution of plants—chiefly improved varieties of fruits and seeds of rice, maize, cotton, fodder, green manure crops, and vegetables—during the year. In this connection I should wish to acknowledge the assistance rendered by Mr. Alex. Perera and Mr. D. D. Fernando of the School Garden staff. The seedsman's records for 1908 show that approximately 7,000 packets of seed and 1,000 plants were distributed during that period.

The following list indicates some of the introductions, made in many cases at the special request of members:—*Cenchrus biflorus*, Chou mœllier, *Sesbania aculeata*, Soy bean, Teff, lemon-scented Eucalyptus, Mysore Coffee, Buckwheat, Dindigul Tobacco, Jute, Cowpeas, Moulmein Paddy, Logwood, Safflower, Casuarina, Carolina Golden Rice, Indigo, Senna, and Sea Island Cotton.

In this connection it should be mentioned that the Society was able to meet a large demand for paddy and vegetable seed for distribution in the distressed areas in the North-Western Province.

A variety of seeds (paddy, cacao, papaw, teak, tobacco, shade trees, &c.) were sent to the West Indies, United States of America, Philippine Islands, Java, Portuguese East Africa, Bengal and Madras Presidencies, the Maldives, Burma, New Hebrides, and West Australia. Locally a system of exchange has been carried on by means of the School Garden organization.

The thanks of the Society are due to the Royal Botanic Garden, Peradeniya, for grants of seeds and plants.

AGRICULTURAL EDUCATION.

The Committee appointed by the Society to report on this subject, and consisting of the Director of the Royal Botanic Gardens, the Director of Public Instruction, Sir Solomon Dias Bandaranaike, the Hon. Mr. S. C. Obeyesekere, the Hon. Mr. P. Arunachalam, Dr. H. M.

Fernando, and the Secretary of the Ceylon Agricultural Society, recommended: (1) That the number of school gardens should be increased and the work further encouraged by the offer of a larger number of prizes; (2) that arrangements be made for a course of lectures to teachers on Nature Study on the same lines as the present sanitary lectures; (3) that Dr. Willis and Mr. Lock be requested to prepare a Manual of Nature Study lessons, and that the Superintendent of School Gardens be asked to prepare an Agricultural Reader for Ceylon, both to be translated into Sinhalese for use in village schools; (4) that definite agricultural teaching be provided and illustrated by practical experiments in a select number of vernacular schools; (5) that the curriculum for teachers under training at the Government Training College be made to include Nature Study, and that a special teacher be appointed to take charge of this work as soon as one is available; (6) that a school of agriculture be started at Peradeniya for the training of Agricultural Instructors, and a course of training be provided for the benefit of candidates nominated for village headmanships.

Since this report was submitted, the subject of Agricultural Education was brought prominently before the Board in the form of a scheme drafted by Mr. W. A. de Silva. At the present time the whole matter is in the hands of a new Committee appointed by His Excellency the Governor to consider and report upon a comprehensive memorandum which His Excellency has himself written on the subject for their guidance. This new Committee is composed of the Hon. Mr, Lewis. the Hon. Mr. Booth, the Director of the Royal Botanic Gardens, the Director of Public Instruction, Dr. H. M. Fernando, Mr. S. D. Mahawalatenne, and the Secretary of the Ceylon Agricultural Society.

AGRICULTURAL CAPITAL.

The Organizing Vice-President has repeatedly referred to the great need for capital in rural agriculture, and explained how the lack of it hinders agricultural progress among the poorer classes who form the bulk of the rural population. Laudable efforts have been made by a few branch societies to meet this difficulty. Chief among them is the Dumbara Branch, whose co-operative credit society has been successfully worked through the efforts of Mr. W. Dunuwille, Disawa, Mr. R. E. Paranagama, Ratemahatmaya. and the indefatigable Secretary, Mr. C. Rasanayagam Mudaliyar. A recent report on this institution will be found in the "Tropical Agriculturist and Magazine of the Ceylon Agricultural Society" for February, 1909. Similar operations, though on a smaller scale, have been carried on by the Telijjawila and Galle Wellaboda Pattu Branches. In all these cases the transactions were confined mainly to loans of paddy. The subject of loans to cultivators has been well ventilated at recent Board Meetings—the chief contributor being Mr. A. Dissanaike, late President of Salpiti korale. At the suggestion of the President, further contributions were invited by the Society from those qualified to advise, and the papers received in response are now before His Excellency, who has announced his intention of submitting his own memorandum to a special committee to be appointed to deal with the matter.

TRANSPLANTING IN PADDY CULTIVATION.

This mode of cultivation, which the Society has done much to foster by means of leaflets, lectures, and demonstrations, is gaining ground, receiving particular attention at the hands of the Mudaliyars of Weligama, Galle Wellaboda Pattu, Bentota-Walallawiti korale, Pasdun Korale East, and Rayigam korale. A number of school gardens, notably that at Paraduwa, have helped in this work through the successful experiments carried out by the school boys themselves. Accounts of these experiments have appeared from time to time in the Progress Reports, tending to show that the advantages of the system are being appreciated.

MANURING.

The necessity for employing green manures or artificial fertilizers is now more generally recognized by native cultivators, and the manuring of paddy is following that of coconuts. Messrs. Freudenberg & Co. have come to the aid of the Society in its efforts to demonstrate the efficacy of manures, as fertilizers or correctives, and, though that firm is likely to ultimately benefit through their enterprise, the Society appreciates their co-operation in showing the cultivator how he could increase his crops. In the North, where animal and vegetable manures are systematically used, and at considerable cost, the economy of employing prepared mixtures has been proved by experiments carried out by the Agricultural Instructor stationed in Jaffna.

ROTATION OF CROPS.

The advantage of adopting a rotation, wherever possible, has been pressed upon cultivators in the Sinhalese-speaking

areas at every opportunity, particularly in connection with the much-condemned chena system, the chief objection to which, from an agricultural point of view, is its improvident method of cultivation. The opportunity presented for enforcing certain regulations for conserving soil fertility by fixing rotations for different districts and requiring the periodical manuring of land is one that should not be missed by Government, which, while it is obliged to countenance a primitive system of land tenure and cultivation, could at the same time teach agricultural economy and discipline. Arrangements have practically been completed for carrying out demonstrations in the continuous cultivation of chena lands at a few centres with the help of the Government Agent of the North-Western Province.

School Gardens.

The report of the Superintendent of the School Gardens for last year records continued progress in this department. The number of gardens working under the scheme is 180, and, what is most encouraging, teachers are entering fully into the spirit of the movement. The desire on the part of aided schools to participate in the scheme goes to indicate that it is appreciated as an educative factor. The best work, generally speaking, is to be seen in the Kurunegala District, though individual cases of special excellence are found in the Western Province. In Uva, Matara, Kandy, Matale, and Kegalla Districts, progress is satisfactory, in other parts there is still much up-hill work to be done.

The proposal to specialize in agriculture, in schools where special facilities exist, has been approved of tentatively. One monitor is at present under-going a training at the Government Stock Garden and the Royal Botanic Gardens, Peradeniya, with a view to being appointed to the School Garden at Mirigama.

Sericulture.

There is no progress to report as regards mulberry silk worm culture through the silk farm which, indeed, has temporarily suspended operations to allow time for the growth of mulberry plants.

As regards eri silkworm culture, prospects are better. A French firm of spinners have made an encouraging report on a 50-pound sample from which an excellent specimen of yarn was turned out. It is found that mulberry and eri silk will not dye uniformly in the same bath. The firm referred to has offered to finance an experiment in the rearing of the eri worm on a commercial scale, and negociations regarding this proposal are still in progress. In the meantime another firm (Swiss) has sent a quotation, which, for the sample submitted, is decidedly encouraging. A small order for 200 lb. for purposes of experiment has already been filled, and if the trial is a success, an annual demand of some 200,000 lb. will be forth-coming. An enterprising Sinhalese gentleman is arranging to establish a silk farm on a commercial basis with a view, if possible, to ultimately meet this demand.

Bee-Keeping.

Bee-keeping continues to make, necessarily, slow progress. Through the kind help of Mr. Herbert Campbell, late of Nuwara Eliya and now in England, it is hoped that comb foundation for *Apis indica* bees will very soon be available. Among the foreign bees that are being tried are Carniolans and Cyprians. With the new miniature double hive designed by Mr. Shanks for the native bee, the complete domestication of this excellent honey-gatherer is much nearer at hand. Hives have been established at three school gardens.

Live Stock.

The Government Dairy continues to be the chief organized agency for the improvement of our local breed of cattle. Its influence, though slow, has spread far. It is through the Veterinary Department that any further measures to hasten such improvement can be satisfactorily controlled, and the expansion of that Department is much to be desired for this and other reasons.

Castration work was carried on systematically for two years, but owing to a strong prejudice on the part of cattle owners, who believe that the operation spoils bulls for ploughing, it is now done only by special request.

The provision of adequate pasture, and the cultivation of fodder plants, must also be looked to for the improvement of cattle for agricultural purposes. In South India, where there is practically no pasture, and no waste land to speak of, the cultivator is forced to grow fodder crops—chiefly sorghums—to meet the difficulty. Here the village bull is allowed to wander about seeking what he may devour, proving a fruitful source of litigation, and from his peripatetic nature making the control of contagious disease a herculean task for the Government Veterinary Surgeon and his small staff of Stock Inspectors.

The year was marked by a serious outbreak of rinderpest, which has unfortunately not been stamped out as yet.

Stock Inspectors.

In addition to their veterinary duties the services of these officers, when not otherwise engaged, are available for agricultural work. Mr. Wijenayake

stationed at Kurunegala, proved useful in looking after the school gardens in the North-Western Province, and has showed his interest in their success by a gift of 100 fruit plants for distribution among them.

Occasionally it has been found necessary to utilize Agricultural Instructors for veterinary duties. In connection with the recent outbreak of rinderpest in the Eastern Province, Mr. Breckenridge, Agricultural Instructor stationed at Batticaloa, assisted in enforcing the regulations of the Veterinary Department.

PASTURE.

The necessity for providing pasture where cattle could be grazed on certain terms has been pressed upon the Society from more than one quarter, and some practical results will probably be apparent before long in Badulla, Gampola, and Ambalangoda, where the question has been under consideration. An elaborate scheme has been submitted by Mr. S Chelliah, Agricultural Instructor, with a view to meeting the difficulty that arises in the Jaffna peninsula during the dry months of the year, when cattle have to be sent to the mainland for grazing purposes at considerable risk and cost.

This scheme, which has the sympathy of the Government Agent of the Province, will, if found practicable, confer a great boon on the agricultural classes, and, if properly controlled, should, even from a commercial point of view, prove a success. At present the selection of a suitable area of 100 or 200 acres is under consideration.

PLANT PESTS, &C.

The newly-constituted Plant Pest Boards began to operate with the appearance, or rather discovery, of the coconut stem bleeding disease, which, however, under the control of Mr. Petch and his staff of inspectors, has so far abated, as to allay the serious apprehensions which beset the coconut planter.

Specimens of insect and fungoid pests have been forwarded to the Government Mycologist and Entomologist from time to time, and their advice has proved of much value.

The Agricultural Chemist has kindly furnished analyses of soils and vegetable products for the Society whenever called upon.

TOBACCO.

The proposed experiment in tobacco cultivation, in order to ascertain the possibilities of raising produce likely to find a place in foreign markets, has still to be undertaken. The initial difficulty as to site has been got over by the decision to conduct the trial at Maha Iluppalama Experiment Station, where there is suitable land available. A subsequent difficulty arose with regard to the services of an expert to control the experiment. The remuneration expected by such a man is considered out of proportion to the funds available, which are made up of a Government grant of Rs. 7,200 plus the Society's vote of Rs. 27,500. At present there is a proposal before the Tobacco Committee to send some one to study cultivation and curing in the tobacco growing countries of the East, with a view to ultimately placing him in charge of the experiment.

The opinion of an expert in the tobacco trade in England is being obtained on samples of Ceylon tobacco. So far, the only encouraging report received is that on Dumbara leaf.

COTTON.

The Society's efforts to introduce cotton growing on an extensive scale have up to date not been attended with very encouraging results, though there is a general desire to take up the cultivation. The chief drawback has been uncertainty regarding (1) the cotton area, (2) the proper season, and (3) the best variety to grow in this country.

The opportune visit of Mr. McCall, Director of Agriculture in Nyassaland, will probably prove to be the means of settling all these doubts. Possessing wide and intimate experience of cotton cultivation, Mr. McCall, at the request of His Excellency the Governor, prepared a comprehensive report on the subject with reference to Ceylon, and his advice will no doubt be the means of helping growers to successfully place their produce on the English market.

IMPLEMENTS.

The introduction or adaptation of implements from abroad has been a good deal before the Society, and with the advice and assistance of Mr. William Hunter, of Messrs. Walker, Sons & Co., a number of suitable ploughs, &c., have been tried on different kinds of soil in various parts of the Island. In the north, where dry-land ploughing is practised, the introduction of improved implements has not met with insuperable obstacles but in the Sinhalese districts, and in wet cultivation there are serious prejudices to contend with, since the cultivator strongly objects to alter his primæval programme for the preparation of his field by ploughing it when it is in suitable condition for carrying a mould board plough.

The success of the implements working at Maha Iluppalama Experiment Sta-

tion ought to convince the most sceptical that it is possible to use such effective labour-saving appliances in most soils. At the Anuradhapura Show held on May 6 a practical demonstration of the working of up-to-date implements was one of the most interesting features of the function, and certainly the most useful from an educative point of view.

ACKNOWLEDGEMENTS.

The Society is indebted to Government for the continuance of its annual grant, to His Excellency the Governor for the encouragement afforded by his presence at Board Meetings, and the interest he has at all times shown in the work of the Society, to the Director of the Royal Botanic Gardens and his staff for their advice, to the Revenue Officers and their chief headmen for their assistance.

I should wish to express a word of thanks to the Indian Departments of Agriculture, particularly of Bengal and Madras, for their courtesy and reciprocality.

C. DRIEBERG,
Secretary.

CEYLON AGRICULTURAL SOCIETY.

STATEMENT OF RECEIPTS AND PAYMENTS FOR 12 MONTHS ENDING DECEMBER 31, 1908.

Colombo, May 26, 1909.

To the Members of the Ceylon Board of Agriculture :—

GENTLEMEN,—I have the honour to report that I have audited the accounts of the Ceylon Agricultural Society for the year 1908, and that the statement of receipts and payments, which I have to-day signed, is to the best of my belief correct.

The audit has been conducted upon the same lines as described in my report dated September 25, 1908.

I find that various liabilities, amounting together to Rs. 439·48, were incurred in 1908, but were not discharged until 1909, and are consequently not included in the present account. As long as the present practice is adhered to, of preparing only a cash account instead of a revenue account, it is very desirable that a special point should be made of discharging as many liabilities as possible in the year in which they are incurred.

Since the close of the year about Rs. 600 has been collected in respect of subscriptions for the year 1908, but a large number of subscriptions still remain unpaid. Some of these will be recovered, but many are regarded as doubtful. I am writing a special letter to the Secretary on this subject.

I have pleasure in stating that the Cash Book is neatly kept, and the vouchers methodically arranged, and that all my inquiries have been readily answered,

I am, &c.,

H. P. CHURCH,

Auditor.

STATEMENT.

RECEIPTS.		Amount. R. c.	Total. R. c.
Balance at Bank of Madras, December 31st, 1907 ...		—	20,633 92
Members' subscriptions :—			
Local subscription for 1906		10 0	
Do 1907		168 0	
Do 1908		4,799 0	
Do 1909		232 0	
Foreign subscriptions ...		426 50	
		5,635 50	
Less paid to *Ceylon Observer* for foreign subscriptions :—			
On account 1907	371 15		
Do 1908	292 87		
		664 2	
			4,971 48
Government grant :—			
Grant for 1908 ...		—	30,000 0
Seed supplies :—	Purchase.	Sales.	
Vegetable seeds, April	308 18	301 91	
Do October	236 80	271 15	
Paddy	11 75	5 0	
Cotton seed	1 43	150 0	
Sapodilla grafts	6 21	40 75	
Bellary onions	16 87	3 50	
Indian arecanuts	12 95	7 0	
Grafted plants	481 15	318 50	
Winged aspragus seed	—	1 50	
Ground nuts	26 53	30 0	
Udo plants	2 10	—	
Maize and Buckwheat	12 56	—	
Dadap seed	1 95	—	
Sundries	10 91	5 60	
	1,129 39	1,134 91	
	5 52		5 52
Interest :—			
On Bank of Madras account ...			510 26
Total ...			56,121 18

PAYMENTS.

		Amount. R. c.	Total. R. c.
General expenditure :—			
Personal emoluments :—			
Organising Vice-President	3,000 0		
Secretary	3,000 0		
Clerks & peons	2,440 0		
Agricultural instructors	862 13	—9,302 13	
Stationery ...		157 5	
Postages and telegrams ...		606 1	
Office furniture ...		23 39	
Bank charges and commission ...		7 96	
General printing ...		38 75	
Misscellaneous petty expenses ...		180 40	
Auditor's fee for 1907 accounts ...		150 0	—10,465 69
Travelling expenses :—			
Secretary, Ceylon Agricultural Society and Staff ...		1,182 34	
Agricultural instructors		1,629 30	
Show Judges ...		76 99	
Organising Vice-President and staff ...		544 65	—3,433 28
Tropical Agriculturist and Magazine of Ceylon Agricultural Society :			
Printing English Magazine (less sales, R5)		5,790 69	
Sinhalese Magazine Editor's fees	450 0		
Sinhalese Magazine printing, postages, &c.	433 91		
	883 91		
Less subscriptions received	795 14		
		88 77	
Printing Tamil edition ...		200 0	—6,079 46
Carried over ...			19,978 43

	R. c.	R. c.
Brought Forward ...		19,978 43
Agricultural shows :—		
Grant to Balalla, Pilessa, & Kuliyapitiya shows	150 0	
Cost of medals ...	137 50	
Expenses on exhibits for Mysore ...	36 10	
Storing show building materials ...	10 0	—333 60
Sericulture Experimental Farm :—		
Upkeep allowance for 12 months ...	480 0	
Repairs of buildings, &c.	153 55	
Purchase of cocoons ...	261 43	
Despatch of cocoons to Paris ...	19 99	—914 97
Experimental Gardens, &c:—		
School gardens grant (out of which R14·51 subsequently returned) ...	500 0	
Loan to villagers on account of experimental coconut cultivation..	150 0	
	650 0	
Less refund on account Mahauswewa rubber experiment ...	48 50	—601 50
Seed Store at Government Stock Garden :—		
Cost of furniture, &c.	—	27 46
Castration of cattle :—		
Cost of sundry demonstrations ...	707 65	
Less refunded on account 1907 ...	36 12	—671 53
Sundry payments :—		
Apiculture experiment	106 77	
Agricutural implements	40 24	
Fibre machinery ...	71 46	—218 47
Balance in hand December 31st, 1908 :—		
At Bank of Madras ...	33,311 93	
Dishonoured cheques in hand ...	55 0	
Stock of stamps ...	8 29	—33,375 22
Total ...		56,121 18

I certify that I have prepared this account of receipts and payments from the books of the Society, and that to the best of my belief it is correct, as per my report of this date.

Colombo, May 26, 1909.

H. P. CHURCH,
Incorporated Accountant.

THE AGRI-HORTICULTURAL AND INDUSTRIAL SHOW, MANNAR.

REPORT BY MR. ALEX. PERERA.

This was the first Show ever held in Mannar, and for a first attempt it more than realised expectations. The exhibits were displayed in six cadjan sheds and two tents. In spite of the drought which prevailed during the last three months, and the lateness of the season, most of the vegetables and fruits shown were good and, judging from the Tomatoes, Cucumber, Beet, Knol kohl, Carrot and Lettuce exhibited by Mr. C. Zanetti, I. E., it would appear that even in dry and distant Mannar, with a little care and attention, it is possible to grow many varieties of native and exotic vegetables and fruits of good quality.

There was a large collection of Pumpkins, Melons and Cucumbers of different varieties, Bandakka, Brinjal, Chillies, Beans and Spinach were of very fair

quality. Yams and Onions were not well represented.

Pomegranates, in the fruit section, were the best I have seen anywhere, and the oranges, limes and plantains were good; mangoes, papaws and pines (of the common " rock" variety) were not so good as they might have been, and the custard apples were altogether poor. Grapes were represented by three small bunches.

In the class of Commercial Products, there were some fairly good bunches of ordinary and king coconuts, gingelly, margosa, coconut and mi (iluppai) oils of fair quality. The different products of the Palmyrah palm naturally took a prominent place in this section, and "Odiyal" flour, jaggery and "Pinnadu" were well represented. A large quantity of tobacco was shown, as well as some cigars, all of poor quality. There were several bottles of wild honey, and some combs of *Apis florea*, as well as a few varieties of gums and resins, and only two "hands" of betel of poor quality. In a place like Mannar the exhibits of preserved fish was expected to be large and varied, but it was rather disappointing.

The products of the Palmyrah again, in arts and manufactures, were well represented. Mats, baskets, hats, ropes of good workmanship, and other articles of every day use were shown in fair quantity. A few pieces of wood and coconut shell carvings, as also a fairly good collection of lace and drawn-thread work, were exhibited. Agricultural implements were represented by some native ploughs, and the fishing industry by a few specimens of fishing lines and nets. Iron work, pottery and tin work were very poorly represented.

The collections of paddy and dry grains were interesting. Of paddy there were eighty-two varieties, and about fifteen to twenty from the district. Dry grains chiefly consisted of Kurakkan, Ulundu, Kampan Pillu, Indian Corn, Kadai Kanni, etc.

Live stock was represented by some seven pairs of cart bulls, a Sindh bull and cow, six buffaloes of good average quality. Native bulls and cows were poorly represented in every way. There were besides eight pairs of goats, three pairs of sheep, one sow, seventeen entries of poultry, six of ducks, two each of turkeys and Guinea fowls, three Mannar ponies and three donkeys were also shown, and the following wild animals, viz., deer, pea fowl, monkeys, parrots, squirrels, mungoose, jackals, hare, cranes, pole-cats and canaries.

Dairy produce consisted of about sixty bottles of buffaloe and cow ghee, butter of poor quality, milk, curd, fowls' eggs and ducks' eggs.

Some good fruit preserves, jellies, pickles and milk-wine were also shown, as well as cakes, bread and native sweetmeats.

I helped in the arrangement and judging of the vegetables, fruits and live stock and dairy produce—the latter in conjunction with Dr. Tillakaratne.

A meeting of the local Agricultural Society was held on the following day under the presidency of the Assistant Government Agent. I was present at this meeting by request, and spoke a few words on behalf of the C. A. S., regarding its aims and objects. I understood from the remarks made by the Chairman that, although there had been a long interval between this meeting and the last one, with this Show it was expected that a new era in matters agricultural had dawned. The success of this Show was chiefly due to the keen interest taken by Mr. Stevenson, Assistant Government Agent of Mannar, in whom agricultural interests find a warm supporter. It is to be hoped that this successful Show may be the forerunner of many more.

Alex. Perera,
Assistant Superintendent, S. G.

ANURADHAPURA SHOW, MAY, 1909.

Report by Mr. N. Wickremaratne, Agricultural Instructor.

A Show in Anuradhapura cannot of course be judged by the same standard as Shows held in Colmobo, Galle, or the larger towns. But, considering the climate of the North-Central Province, the nature of the produce and the distances from which exhibits have to be brought, it must be admitted that the Show was a success. The numbering of exhibits was carefully done, and the exhibits themselves were representative of all products of the Province, except live stock, the addition of which would have made the Catalogue complete.

The demonstrations of the improved implements were greatly appreciated by the villagers who had the good fortune to be present. This shows that even the most conservative "goiyas" can be lifted up from his apathy if he is given practical and ocular instructions.

The exhibits themselves were good, and, except for one or two items in the vegetable class, all sections were represented. The quantity of paddy and rice required for exhibit might have

been larger. There were several good bunches of coconuts. All the exhibits of the citrus family: oranges, mandarins, heen-naram, limes, citrons, etc., were excellent. Plantain (especially the cooking variety), pumpkins, yams, (including cassava and sweet potatoes), were all good, but better specimens of Indian Corn should have been forthcoming. The curing of the tobacco exhibited was not satisfactory. Cotton, the future hope of the N. C. P., made a poor show.

Four of the School Gardens sent a collection of their produce; they were all most creditable.

The Society had a special stand for its publications and seeds which were freely given away.

N. Wickremaratne,
Agricultural Instructor.

HANGURANKETA A. H. SHOW.

Report by Mr. Alex. Perera.

The Agri-Horticultural Show which was held at Hanguranketa, in connection with the Empire Day celebrations, on the 24th May, was the first held in the district. The large Ambalam, in front of the historic Temple, was enclosed and utilised for the display of exhibits, and it was full to overflowing. I assisted in the judging of Fruits and Vegetables, Mr. W. Molegoda, Agricultural Instructor, being associated with me. The most noticeable exhibits in fruits, both for quality and quantity, were the papaws and citrons. Mangoes were unripe, and the oranges as a rule inclined to be acid. Pomegranates, limes, coconuts, and jak were fairly good. I would make special mention of two plates of grapes and a few mangosteens grown in the district. The grapes (both fruits and bunches) were of very fair size. Among vegetables there was a goodly collection of pumpkins, ash pumpkins, luffa, brinjal, tomato and cooking plantain of average quality. Bottle gourds, bandakkas, drumsticks, cucumbers, snake gourds, and cabbages were rather poor. There was also a good collection of English vegetables and uncultivated vegetables. But the most noticeable exhibits in this class were the capsicum chillies and onions; they were well above the average.

Three schools competed for the school garden prize, viz., Karandagolle, Ekiriya and Munwatte. Ekiriya was awarded the 1st prize, and Munwatte Hon. Mention for collection of School Garden produce from the respective schools.

Commercial Products were represented by coconut, mi, castor, and kekuna oils tobacco, cigars, cotton, rubber and medicinal products. The oils and tobacco were good.

Food Products consisted of coffee, Indian corn, cacao, paddy, arecanuts and betel of average quality. Jaggery and pepper were not very well represented. There were several collections of chena grains, and the prize exhibit of Mr. Andrewewa's was an excellent one.

In Arts and Manufactures there was a good and varied collection of blacksmith's work—hunting knives, catties, hatchets, pruning knives, mamoties, scythes, etc. Special attention was drawn to a combination hatchet, knife, saw, hammer and screw driver, by the well-known Punchirala of Maturata. Some mats and baskets of good workmanship and a box of Kandyan jewellery were also shown. Carpentry was poorly represented. A few good pieces of drawn-thread work, lace embroidery and other needle work were shown. Pickles, preserves, and native sweets, prepared by the ladies of the district, were also exhibited.

Live Stock consisted of some native and cross-bred bulls and cows, a few buffaloes and some poultry of uncertain breed. Excepting a bull or two and a pair of buffaloes the rest of the live stock were poor.

Dairy Produce was represented by ten or twelve bottles of ghee of medium quality.

Extras consisted of an old native cotton ginning machine, a collection of medicinal oils and a few honey combs.

A special prize was offered to the Headman whose division carried off the largest number of prizes.

Alex. Perera,
Asst. Superintedent of School Gardens.

WELIMADA SHOW.

Report by Mr. J. K. Nock.

I have the honor to forward the following report on the Agricultural Show held at Welimada on the 27th and 28th May, at which I assisted to judge.

Vegetables.—The quality was good, especially of Leeks, Garlic, Pumpkins, Brinjals, Chillies, and Bandakkas. Tomatoes, Cucumber, Cabbages, and Potatoes should have been very much better.

Fruits.—Beyond two good pine-apples, one large jak, and several lot of guavas, there was nothing stand-out in this class. Oranges, Limes, Papaws, and Pomegranates were poor for the district.

COMMERCIAL PRODUCTS.—This was a very good class, the Tobacco grown by a Bandarawela resident, and the Cotton grown at Welimada being notable for their good appearance and quality; the Coconuts sent from Udukinda were of good size; and there were very good exhibits of Tea, Yams, and Sweet Potatoes, dry Chillies, and Ginger.

MISCELLANEOUS.—The Pottery, Brassware, and Carpentry work showed clever workmanship, and added variety and interest to the Show.

SCHOOL-BOYS' EXHIBITS.—These formed the stand-out feature of the Show, there being no less than forty-eight exhibits, the bulk of which were of really good class, this being proved by the fact that eleven awards were made.

LIVE STOCK.—There was only one cow shown, but it was worth an award. Most of the bulls appeared to have a touch of English or Australian in them, for which they were disqualified; the price was given for a nice little native bull shown harnessed to a hackery.

TRANSPLANTING OF PADDY.—On the morning of the 28th five paddy-fields were visited, to inspect the work commendably initiated in the district by Mr. Dambawinne, late R. M. The very superior condition of the portions transplanted over those sown broadcoast was remarkable both as regards general growth and crop prospects. As often pointed out previously, this is a work which should receive serious encouragement, and I trust the Parent Society will be able to see its way to help the Welimada branch still further by making some donations of manure to those who have commenced transplanting; their names are;—Mr. Dambawinne, late R. M., Divitotavilla Appuhamy, Divitotavilla Arachchi, and Kalubanda. Every attempt should be made to get larger areas transplanted each year, and careful records should be kept. Prizes were awarded for each plot.

GENERAL.—The whole Show showed marked improvement over the previous one, but the space was inadequate for the exhibits, and next time an additional building should be erected.

J. K. NOCK,
Curator, Hakgala Gardens.

COMMITTEE OF AGRICULTURAL EXPERIMENTS.

MEETING JANUARY 8TH, 1909.

Report of Progress by the Assistant Director, R. B. G.

Meeting of the Committee of Agricultural Experiments held on January 8th, 1909.

Reverting to the Minutes of the meeting held on July 10th, 1908 :—

Photographs of Cacao Machinery were laid upon the table. (The machinery illustrated is far too large for use on E.S., and probably too complicated for economical working anywhere in Ceylon.)

The Still is still undergoing reconstruction. The matter is at present in the hands of Messrs. Bamber and Jowitt.

CACAO.—Considerable progress has been made in clearing up the plots, and the boundaries have been better defined. Cacao planters who were acquainted with the place in its previous state have recently expressed satisfaction with the present condition of the plots.

Four acres of Forastero Cacao are being planted out for treatment as half-acre plots. Mr. Bamber will propose experiments to be carried out on these.

Planting operations of all kinds have been very much handicapped by unfortunate conditions of weather, nevertheless.

An acre (plot 11) of Jequié Manicobar Rubber (*Manihot dichotoma*) has been planted out successfully.

A further 4,000 seeds of the same variety and a like number of seeds of Remanso Rubber (*Manihot Piauhyensis*) received from Kew, have been planted out in nurseries and are germinating.

Two-acre plots for pepper have been surveyed and cleared of undergrowth, but are not yet planted.

It seems legitimate to express some dissatisfaction with the fact that the agricultural machinery ordered early in August through the Crown Agents has not yet arrived, and will have to be paid for out of next year's vote.

Thanks to Mr. Mee's personal exertions, however, a large part of the young coconut plot has been ploughed successfully. An acre of groundnuts, an acre of Hickory King maize, half an acre of Sea Island and half an acre of Egyptian cotton, and quarter of an acre of tobacco have been established.

The girth of practically all the Rubber trees on the Experiment Station has been measured.

The tea plots have been taken in hand and thoroughly tidied up under Mr. Bamber's personal supervision.

Plants of several varieties of oil grasses were very kindly presented to the Experiment Station by Mr. Jowitt. Small plots of the following have been established :—

Maha-pengiri.
Lena-batu-pengiri.
Cymbopogon flexuosus.
C. polyneuros.

Cymbopogon Martini most unfortunately failed, owing to a misguided effort to get too many sets out of a small plant.

A series of small show plots has been laid out near the office at Mr. Bamber's suggestion.

I cannot help remarking in conclusion that, although there has not yet been time or opportunity for carrying out quite all the resolutions of the last two meetings, still the Committee may very properly congratulate itself on the great improvement in general appearance, and still more upon the real progress in experimental work which has been made during 1908. For this progress the greatest credit is due to the Superintendent and staff of the Experiment Station.

R. H. LOCK,
Assistant Director, R. B. G.

PROGRESS REPORT ON EXPERIMENT STATION, PERADENIYA.

Submitted to the Committee of Agricultural Experiments on March 11th, 1909, by Mr. Kelway Bamber, Government Chemist.

Since the last meeting January 8th, 1909, I took over charge of the experiments on Gangraoowa from Mr. Lock.

Practically all the suggestions of the minutes have been carried out, or the work commenced as far as climate and conditions allowed.

TEA.—Plot 141 has been forked up alternate lines and mulched with compost of jungle material

The plot to be manured artificially will be done after the pruning, which is soon due.

Plots 143 and 147 have had the alternate lines forked and crotalaria cut and heaped for the second time; 3,609 lbs. and 1,755 lbs. being obtained respectively. The plots were not forked at the first cutting and the material was more or less lost.

Plot 148 will be sown with crotalaria and slag and potash just before pruning.

Plots 151 to 154 have been supplied with Para stumps from old trees and young trees and will be re-supplied.

The Hon'ble Mr. Turner suggests one plot should have prunings buried and the other forked and heaped for comparison using Basic slag and Potash only.

COCOA.—All the experiment plots have been manured; those receiving single constituents have had the amount doubled so as to get a more marked effect.

All the supplies in the plots have been forked and mulched with mana grass.

Experiments are being conducted to train shoots to form lateral branches where needed, with promising results.

The cocoa plots from seeds of special trees have been manured with a soluble mixture, forked and mulched with already marked results.

Five acres of cocoa from No. 2 tree of Forastero from Plot 1 have been planted 15×15′ and Dadap stumps put in as suggested for shade and manurial purposes.

Mixed crotalarias and Indigofera have been sown on one plot.

This cocoa was put out in baskets, shaded, the ground forked and mulched with Micania scandens, &c., and hardly a vacancy is to be seen notwithstanding the drought.

PLOTS.—The acreage has been divided into 10 half-acre plots.

Plot No. 119 has been forked and mulched as suggested. A little canker appeared here and there through the cocoa, but this has been carefully removed. The unmanured plots above the paddy and near the river had 40 to 50 trees and the manured plots 5 or 6 only. All the trees have been measured in every plot.

RUBBER.—PARA: Plot 78 has been manured with ammonium sulphate 150 lbs., Concentrated superphosphate 100 lbs., Sulphate of potash 100 lbs.—350 lbs. in rings round the trees, forked and mulched.

Plot 79 has been drilled with Crotalaria 18″ apart
81 ,, ,, Indigofera 18″ apart
both without manure as yet.

Plot 80 has had one row mulched with Lemon grass. All have been weeded clean and all the trees measured.

CEARA.—Experimental tapping has been commenced on these.

DICHOTOMA.—The clearing 20×20′ planted October, 1907, has been kept clean weeded. The clearing 12′×12′ has been established with hardly a vacancy notwithstanding the drought.

350 A new clearing 6′×6′ has been lined and is being planted.

A fallen tree of the first clearing was cut into 18″ lengths, and supplied 56 cuttings all of which are growing.

Seed from the young trees have been collected and are germinating well.

PIAUHYENSIS.—There are very few plants of this variety, so a plot has not yet been made.

CASTILLOA.—Experimental tapping has been commenced on the lower row of Plot 129.

COCONUTS.—A census has been taken giving 927 trees available for experiments

These have been divided into plots of 60-70 trees practically one acre each, and some of the treatment suggested has been commenced. The nuts will be collected separately from the next plucking so that the manurial results, which will hardly be apparent for two years, except perhaps on the foliage, can be compared with present yields of each plot as well as with the control plots.

The barbacue has been prepared for copra making and the chekku oil mill also repaired so that oil estimations can be made from the manured plots. Owing to insufficient labour it has been impossible to remove the coconut trees from the cocoa manurial plots as yet.

SISAL.—A plot of sisal fibre has been made from suckers from the Royal Botanic Gardens planted 8′ × 8′.

Several new plots of leguminous plants have been established, including the Berseem variety of Clover from Egypt. Various beans from the Togo Islands, Soy beans from the United States, &c.

CITRONELLA.—A plot of the pure Maha Pengiri from Java plants has also been made. It is expected that this variety may replace the others used in Ceylon.

LOSS OF SOIL.—Five plots of one-fiftieth of an acre have been made on sloping ground and planted with Desmodium, Crotalaria, Dadaps, Albizzias and control.

PADDY.—Small green manuring experiments with native beans have been done and others with Berseem Clover will be commenced.

STORE.—Cocoa fermenting experiments have been done with satisfactory results, the best system apparently being to ferment 12 hours, partly wash, ferment again 24 hours, wash, again ferment 24 hours, wash and dry as rapidly as possible. These experiments are being continued.

Some Nitro-bacterine samples have been received, and the method of application will be shown.

Label boards have been made and marked with the variety of plant, date of planting, manuring, &c., and others will be done for *all* the experimental plots.

VISITORS.—Several Planters and Visitors have been shown round the estate ; the former taking special interest in the green manuring experiments.

M. KELWAY BAMBER,
Government Chemist.

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

Submitted to the Committee of Agricultural Experiments, May 13, 1909.

RUBBER.—Plot No. 12 *Manihot Dichotoma* has been planted successfully 6′ × 6′. 98 % good. Three blown down trees of *Manihot Dichotoma* have been cut and planted, every cutting of a previous tree having struck well.

Manihot piauhyensis plot of 67 trees established 12′ × 12′ near the Temple on the Papaw plot. All stumps removed and land ploughed.

Measured Para Rubber on Lemon grass plot.

Tapping experiments on Castilloa plot 129 in progress on the bottom row by Mr. Rothwell.

Ceara tapping also tried with varying results.

TEA.—Plot 141 mulched with fresh jungle material 508 lbs. up each line as before by 36 lines—about 18,300 lbs.

Plot 142 had alternate lines forked and crotalaria and indigofera sown up the lines.

Assam hybrid plots re-supplied from Seaforth estate, Dolosbage.

All the boundary dadap trees pruned to 4′.

Rested bushes on plots 151 to 155 are being pruned and have formed good wood.

Plucking has been to the fish leaf for six rounds on the indigenous and hybrid plots, and four rounds on the single indigenous, when whole leaf plucking was resumed.

The yields from plots 149 and 150 have been very good, viz., 731 and 749 lbs. in April, while plots 145 to 148 have given over 500 lbs. green leaf.

The indigenous plots are being supplied with Manipuri from Mr. J. R. Fairweather, Mabopitiya Estate, Kegalle.

COCOA.—5 acres all planted and supplied dadaps, all taking well.

Land all ploughed. One-half acre sown with mixed crotalarias and indigofera on steeper portion.

All stumps have been removed and Arecanuts cut out.

Canker excision continued as usual, very few trees being affected.

All suckers removed every two months.

Mr. Rettie sent two coolies to be taught the process of Canker excision.

Remaining plots 94 to 96 A & B have been manured, and all experimental plots labelled.

All Pomelo trees with parasites removed from along the main drive.

GRASS.—The contract has been taken from Mr. Alwis and the grass is being sold daily at 3 cents a bundle, about 120 bundles per day.

LOSS OF SOIL.—The silt was weighed on the 27th April after some heavy rains, with the following results :—

Plot 1.	Desmodium triflorum	282 lbs.
2.	Crotalaria up the slope	543¾ ,,
3.	Dadaps ...	1,685 ,,
4.	Blank ...	1,653½ ,,
5.	Albizzias ...	661 ,,

The three last plots had some self-sown crotalaria about them, which saved a little wash, but the dadaps and albizzias are not yet affording any protection.

GREEN MANURES.—New plots have been made of

Boga medeloa from India.
Tephrosia hookeriana from Sarawak.
Indigofera hirsuta.
Tephrosia villosa from Maha-illuppalama.
Tephrosia purpurea, var pumila ,,

COCONUTS.—The manuring experiments have not yet been commenced beyond marking out the trees in lots of about 70 or 1 acre owing to want of labour.

PADDY.—Various beans were sown in small plots for green manuring purposes and grew fairly well, but were all taken by the Sinhalese and coolies.

The one acre plot of Indian corn Hickory King was reaped in 2½ days by 18 coolies at 34 cents average.

	4,433 plants	weighing	4,553¼ lbs.
yielded	3,824 cobs	,,	2,051¼ ,,
gave	1,219¼ lbs of dry seed.		

Fibre and cob covers 785 lbs.

STILL.—A small still has been repaired and erected for distillation of the small plots of pure grasses. About two acres of land have been cleaned and prepared for the citronella oils.

A Rubber-smoking apparatus has been received from Mr. Wickham of Brazil, and can be seen working after the meeting.

NOTES AND QUERIES.

J. A. G. J.—It is not necessary to plant a grafted plant up to the point of grafting. Where the point is low on the stock this might be done; but where it is high it would not be desirable to do so, as the roots will then be smothered. A well grafted plant should not die down if carefully handled and protected from injury.

BLACK HAMBURGH.—I would hesitat to advise your trying to grow grapes in the Western Province, which is far too wet, though I have known exceptional cases of productive vines in Colombo, and there are still some in Matale which is a wet district. Besides the dry North where the Black Hamburgh variety is now being tried, the Eastern, North-Eastern and Uva Provinces, Chilaw, Puttalam, Hambantota and Hanguranketa districts are likely to suit the grape. The Continental and Australian system of low pruning does not suit our conditions of climate in Ceylon where there can be no "wintering." Mr. C. Zanetti, Irrigation Engineer in charge of Giant's Tank, is perhaps the best local authority on the subject of grape cultivation.

F. D. W.—The *Queensland Agricultural Journal* for November last refers to the packing of mangoes for transport and recommends the Safety Export Fruit Case. It is described as a basket box 20¼″ long, 9¼″ wide and 6¾″ deep. Inside this a set of cardboard "pockets" is placed in which the fruit is packed, each fruit thus having a ventilated compartment to itself. After the packing of the bottom layer a flat piece of cardboard is placed on the top along which a second layer is packed, and then the lid is nailed on. The cardboard "pocket" or "filler" is a strip of cardboard just a fraction less than the inside measurement of the case. For a basket such as that described the size would be 20″×9″×2½. This is cut at regular distances, and another strip of cardboard also slit horizontally, is placed transversely across it. The slits dovetail, and thus by placing several pieces in position the box is divided into neat and regular compartments. The above is the regulation size, but it is quite easy to modify the size of the compartments to suit the fruit; it only means cutting the slits in the cardboard at the people intervals. I ought to mention that the Safety Export Fruit Case is protected by patent.

I lately received a case of fine mangoes from Bangalore, carefully packed in straw in a sealed case; but, though the journey took but three days, the fruit reached me quite spoilt.

C. S.—Thanks for your recipé for the preparation of slime-apple confection which I am sure many will be glad to have, and I am therefore giving it below :—

"Scrape out the pulp and, after thinning it with water, strain away the seeds and fibre. Having poured the resulting paste into boiling syrup the mixture should be vigorously stirred with a ladle until it thickens to the

degree that it will harden when cooled. Then spread out the paste on a marble slab and cut into any size and shape you like. During the process of boiling some flavouring essence like vanilla or cinnamom might be added. The proportion might be 2 lb. sugar (for the syrup) to 1 pound of the fruit pulp. The possibility of the extended usefulness, especially from a medical point of view, of this confection of slime-apple (the virtues of which are too well known), like the confections of figs and tamarind now in use, are I think considerable.

C. DRIEBERG,
Secretary, C. A. S.

THE BLOOD OF PLANTS.

(From the *Gardeners' Chronicle*, XLV., 1169, May, 1909.)

It has long been known that the blood of animals contains substances—respiratory pigments—which act as carriers of oxygen; that is, which are capable of uniting with oxygen and of yielding it up to the tissues of the body. Such respiratory pigments are contained, for example, in mammalian blood, and to them that fluid owes its characteristic colour. The change of colour which blood undergoes in passing from the arterial to the venous state is due to the change in colour of the respiratory pigment. When united with oxygen it is bright red, and when deprived of oxygen it is of a darker colour.

Again, it is well known that in the process of respiration, both in plants and animals, the energy which this process releases and puts at the disposal of the organism is in part due to oxidations. The raw materials of respiration are complex organic compounds—sugar and also nitrogen-containing bodies: the final "waste" products of the process are fully oxidised substances, such as carbon-dioxide, water and the like.

It has always been a puzzle to physiologists to understand by what chemical course of events the respired substances are oxidised in the cells of the plant or animal.

It has been evident for some time that respiration is not a simple oxidation process, for if it were, then increasing the supply of oxygen should result in increased respiration. This is not the case with plants, for the amount of oxygen in the air supplied to the plant may be varied within extraordinarily wide limits without increasing the rate of respiration.

That certain processes go on in the plant preliminary to the oxidative processes which constitute the last stage of respiration is evident from the study of fermentation by yeast.

Yeast is a fungus which, as is known to all, converts certain sugars into alcohol and carbon dioxide. Yeast (*Saccharomyces cerevisece*) is remarkable, inasmuch as it may live in the presence or in the complete absence of oxygen; or, in other words, it can live ærobically or anærobically.

When oxygen is present yeast, besides fermenting a certain amount of sugar to alcohol, converts some sugar into carbon dioxide and water, that is, it sets up fermentation and also respires like an ordinary plant. When oxygen is absent yeast obtains its supplies of energy solely by breaking sugar molecules into alcohol and carbon dioxide.

Yeast, as an ærobe, derives the major part of its energy thus:—

$$C_6 H_{12} O_6 + 6 O_2 = 6 CO_2 + 6 H_2 O$$

as an anærobe, thus:—

$$C_6 H_{12} O_6 = 2 C_2 H_5 H O + 2 CO_2$$

and since the energy obtainable from a given weight of fermentable sugar is greater when the oxidation is complete, as in the former case, than when the sugar molecule is split into an unoxidised part (alcohol) and an oxidised part (carbon-dioxide), it follows that, to get the energy necessary for its routine work of living, yeast as an anærobe must decompose considerably more sugar than when it is living as an ærobe. This is confirmed by the experience of brewers, who limit the amount of oxygen available for the yeast during alcoholic fermentation. Till recently the facts of alcoholic fermentation were regarded rather as curious than significant. Two sets of observations have forced them into prominence as throwing light on the chemistry of respiration. The first set of observations indicates that alcoholic fermentation is not confined to yeast and various other micro-organisms, but may be demonstrated to occur among the higher plants. That this is so, anyone may determine very readily by keeping Bean seeds under water for a few days, and then rubbing the seeds between the fingers, when a distinct smell of alcohol is to be recognised. Experiments on the behaviour of the higher plants when deprived of oxygen have led to the conclusion that in these circumstances, though no oxygen is absorbed, carbon-dioxide continues for some time to be evolved; and, as we have just seen, alcohol is also produced. This process of respiration without oxygen is called generally intra-molecular respiration. It agrees in the most exact manner with the alcoholic fermentation of sugar

by yeast, and, indeed, only takes place in plants which contain sugar in their tissues. The second set of observations bearing on the chemistry of respiration are due to Buchner, who has succeeded in isolating from the living yeast-cell a definite substance which he terms zymase, and which, like the living yeast-cell itself, has the power of decomposing sugar into alcohol and carbon-dioxide.

From these results it would appear probable that in yeast, living in oxygen, respiration takes place in a series of stages, of which the first is the disruption by zymase and similar agents of complex, organic substances such as sugar (and also nitrogen-containing bodies), and the second the oxidation of the alcohol and other substances produced by this disruptive action. If this is the probable course of events in the respiration of yeast, it is also, for the reasons already given, the probable course of events in the respiration of all plants.

In this scheme the respiratory pigments find a definite place. These pigments consist of readily oxidisable bodies, and, under the influence of special agents of oxidation called oxidases and peroxidases, take up oxygen. They act as temporary storers of oxygen. The oxygen, which they hold but loosely, is taken from them and induced to combine with the products of the disruptive process described above, with the consequent production of fully-oxidised substances—the so-called products of respiration—such as carbon-dioxide and water. A respiratory pigment may have different colours according as it is in the oxidised or the reduced state; thus indigo is blue in the former, but colourless in the latter condition. Various fungi, such as species of Boletus turn blue when broken and exposed to the air owing to the taking up of oxygen by the respiratory pigment. Many of the common colour changes in vegetables, as, for example, the browning of Apples may be the visible sign of a similar oxidative process whereby a respiratory pigment is converted from its reduced, colourless state to its oxidised, coloured condition; the oxygen so taken up being destined for respiratory purposes. Inasmuch as bodies, having these peculiar relations to oxygen and exhibiting marked colour characteristics when oxidised, exist in the sap of the most varied kinds of plants, it has been suggested by Palladin, to whom the most recent investigations are due, that the cell-sap of plants, because it contains these respiratory pigments and also the oxidising agents, is to be regarded as fulfilling the same respiratory functions as the blood of animals.

Looking at matters from the standpoint of the plant, the problem which it solves by respiration is how to obtain the energy for doing its work. The complex substances which it manufactures contain potentially great stores of energy. All that is required is that these substances should be oxidised. At the low temperature at which plants work this cannot be done directly. It is done indriectly in two series of operations. First, by special, elastic (decomposing) agents, like zymase, the organic substances are split up into intermediate bodies. In the second set of operations oxygen is brought into close association with the respiratory pigments. In the last place, this store of oxygen is introduced to, and caused to combine with, the decomposition-products of the first stage. Thus more or less fully-oxidised products are evolved, the fullness of oxidation being a measure of the completeness with which the potential energy of the original food substance is liberated. Although it cannot yet be described in simple language, easy of apprehension to the layman, the great problem of the mode of origin of the vital energy of organisms, by virtue of which they live and move and have their being, begins to be intelligible.

SCHOOL GARDENS.

THEIR OBJECT, MANAGEMENT, &c.

(*Teachers' Leaflet No. 1 for 1909.*)

The following circular, under the three heads (1) Object of School Gardens; (2) Conditions under which they are worked; (3) Points in the judging of Gardens, is sent for your information and guidance :—

1.—*Objects of School Gardens.*

(*a*) To brighten the surroundings of the school, and make it what it ought to be, viz., a pleasant resort for the boys and not a bare and unattractive building.

(*b*) To lighten the routine of class work by varying it with outdoor work of a recreative nature.

(*c*) To exemplify order, form, neatness, and good taste in the laying out of the premises.

(*d*) To furnish a field for nature study, *i.e.*, the study of natural objects in their natural surroundings.

(*e*) To serve as object lessons in horticulture, *i.e.*, the cultivation of useful and ornamental plants.

(*f*) To give a practical turn to school life, and provide a training in elementary agricultural science.

(*g*) To serve as centres for the dissemination of seeds and plants and of information concerning them.

(*h*) To be mediums of communication between the agencies that aim at the improvement of agriculture, and the cultivating classes.

(*i*) To induce the cultivator, directly or through the school boys, to take up new and improved products and adopt better methods of cultivation.

(*j*) To awaken in school children a new interest in the cultivation of plants, and instil into them a love of nature, and so reconcile them to a country life and to agricultural pursuits.

(*k*) To encourage school children to establish gardens at their homes.

(*l*) To make school boys take an honest pride in manual labour, and induce a healthy competition among them as well as between one school and another.

2.—*Conditions under which School Gardens are worked.*

(*a*) Any school which presents possibilities for school gardening will be furnished with a stock of implements, and supplied with seeds from time to time: where required, fencing wire will also be supplied.

(*b*) Garden work should be carried on by the teacher with the help of the monitors and scholars. After setting aside such part of the produce as is required for purposes of propagation the remainder should be divided between the Headmaster, Assistant Masters, Monitors, and boys who have actually assisted in the work of the garden.

(*c*) In the case of produce not actually used as food, and which it is desirable to dispose of with a view to profit, the amount realised is to be entered in the quarterly report form. The revenue from such cultivation will at the end of the year be equally divided, half to go to the Headmaster, and half to be devoted to a garden prize fund for the school.

(*d*) Quarterly Reports should be furnished in the forms provided.

(*e*) The School Gardens will be inspected periodically by the Superintendent and his assistants, and prizes will be awarded by the Department to teachers who show the best results.

(*f*) A certificate will accompany each prize, setting forth the nature of the award, &c., and certificates of honorable mention will also be awarded to deserving teachers.

3.—*Points to be considered in the judging of School Gardens.*

(*a*) Area cultivated.
(*b*) Situation and lay of land.
(*c*) Climate and rainfall.
(*d*) Number and variety of plants grown: (I) economic; (II) ornamental.
(*e*) Laying out.
(*f*) Arrangement of plants and trees.
(*g*) Grouping for effect.
(*h*) Skill in cultivation.
(*i*) Cleanliness of premises.
(*j*) Cultivation in pots, tubs, and boxes.
(*k*) Bowers and arches.
(*l*) Fruit trees.
(*m*) Fences and hedges.
(*n*) Paths and drains.
(*o*) Lawn and playground.
(*p*) Furnishing of reports and returns.
(*q*) School garden records.
(*r*) Activity and intelligence of scholars.
(*s*) Care of implements.
(*t*) Aptitude and interest shown by teacher.

C. DRIEBERG,
Supt., School Gardens.

AGRICULTURAL CREDIT BANKS.

(*From the Board of Agriculture and Fisheries' Leaflet No. 214.*)

A Credit Bank is a Co-operative Society through which persons in a small way of business may obtain advances of money for useful purposes at a reasonable rate of interest.

Some people may be inclined to question the wisdom of supporting or encouraging any system which makes it easy for a man to conduct his business with borrowed money. This idea, however, is based upon a misconception. The wisdom of borrowing upon reasonable terms is generally a question of the security which the borrower can offer.

Credit is at the foundation of modern business methods. Most public companies work with borrowed money, and so long as the company can show good security for its liabilities, nobody questions the soundness of the principle.

A business man of any standing in the commercial world experiences little difficulty in obtaining temporary advances of money to meet special requirements. But the small man in an agricultural community does not, as a rule, possess the same facilities.

In the days when private banks were scattered up and down the country the position was somewhat different. A trustworthy man could then more easily obtain a credit accommodation merely on the security of his character and position. But with the gradual absorption of private firms into large Joint-Stock Banks conditions have changed. The small farmer, the labourer with his allotment, the market gardener and the village tradesman, may not be in a position to borrow money through the ordinary channels of credit, because ability, experience, and honesty of

character do not necessarily constitute a sufficiently acceptable security for an advance. It is such persons that a Credit Bank is intended to benefit.

A Credit Bank, however, is not a philanthropic institution, but a society based and conducted strictly upon business principles. The distinctive features of a Credit Bank are :—

(i) It is co-operative—its key-note being "Self-help."

(ii) It is local—its members living within a small area and being well known to one another.

These two features will become clearer when we proceed to consider its

CONSTITUTION AND OPERATIONS.

The village or parish is the most convenient unit of area for a Credit Bank. The intending members form themselves into a society which adopts rules and is duly registered by the Registrar of Friendly Societies.

Full information as to the proper procedure can be obtained from the Chief Registrar of Friendly Societies, 28, Abingdon Street, Westminster, S.W. The Secretary of the Agricultural Organisation Society, Dacre House, Dacre Street, Westminster, S.W., will also supply model rules on application, and is willing to conduct the necessary proceedings as to registration.

The Credit Bank appoints its officers and committee of management, and, as soon as it is properly constituted and registered, is in a position to borrow money on the joint security of its members. This money it lends out to those of its members who are at the moment in need of ready money.

Credit Banks do not distribute dividends, and, the expenses of management being very small, money can be lent at a low rate of interest, and this is the main object for which the Bank is formed.

The wisdom of borrowing, it has been stated, depends upon the purpose for which the money is borrowed. The Credit Bank will only lend money for purposes of production or economy. This, however, allows it a wide field of action. To give but a few examples of the useful objects for which money might be advanced there may be mentioned the purchase of implements, seeds, manure, poultry, &c., or the erection of a fowl-house, greenhouse, or pigstye. A member who wishes to borrow money must state the purpose for which he requires it, and must undertake to apply it to that particular purpose. It will then be within the discretion of the Committee to decide whether the loan shall be granted or not.

A Credit Bank can only lend to its own members, and its success will depend upon its admitting as members only those whose industry, honesty, and integrity are beyond question. A man who possesses these qualities should have no difficulty in becoming a member of a Credit Bank, or in obtaining from it an advance of money for any useful and productive purpose. The Bank will, however, require him to furnish sureties for its repayment.

There can be no more thoroughly democratic institution than a Credit Bank. It elects its officers and committee to manage its affairs, but the action of these officers will be subject to vigilant checking, and it will be to the interest of every member to see that the character of the membership is strictly maintained, and that the affairs of the Bank are conducted in an efficient and businesslike manner.

The interest in good management will be the more vital because a Credit Bank of this type must necessarily be conducted upon the principal of the

UNLIMITED LIABILITY

of its members for the money raised by the Society.

Lest this should cause any misgivings as to any risk incurred by the individual members, it should be pointed out that the risk may be most effectually guarded against. The possibility of loss is in any case very remote owing to the effectual control which the members can exercise over all transactions of the Bank, and it is reduced to practically nothing by adopting a rule limiting the amount of money that can be lent either in all or to any one member each year. Section 46 of the Friendly Societies' Act provides that a Society shall not make any loan to a member on personal security beyond the amount fixed by the rules, or make any loan which together with any money owing by a member to a society exceeds £50.

On the other hand, it is just the security of such unlimited liability which enables the society to borrow money without trouble on advantageous terms.

How very remote the risk of loss really is may be judged from the fact that in Germany, where there are between 4,000 and 5,000 societies of the Raiffeisen Union proper, in addition to a much larger number similarly organized, it is said that no depositor or other creditor has lost a farthing since the movement was started in 1849.

In Ireland an almost equal immunity from loss is claimed by the Irish Agricultural Organisation Society, which has about 300 affiliated Credit Banks; and the few existing Credit Societies in England can tell the same story.

DEPOSITS.

To every Credit Bank there should be attached a department for receiving on deposit the savings of its members. The money thus received would to some extent supplement that borrowed by the Society, and would assist it in its lending operations.

CENTRAL BANK.

As Credit Banks are started in various localities, they will strengthen their position and increase their resources by uniting to a Central Bank. Such Central Bank could then receive on deposit any surplus funds from the local Banks, and assist them, if necessary, by making advances. It would, in fact, stand in somewhat the same relation to the local Credit Banks as these would to their individual members. The principle of unlimited liability, however, which is essential in the case of the separate banks, would be generally unsuitable as regards their relation to the Central Bank. In connection with the Village Co-operative Credit Societies affiliated to the Agricultural Organisation Society, a Central Co-operative Agricultural Bank has already been formed.

SMALL HOLDINGS AND ALLOTMENTS.

The useful part which Credit Banks may play in the successful cultivation of small holdings and allotments has been recognized by Parliament, which has included in the Small Holdings and Allotments Act of 1907 certain provisions relating to these and other co-operative institutions.

County Councils are given power under the Act to promote the formation and extension of Credit Banks, and they may, with the consent of the local Government Board, assist such societies by making grants or advances upon such terms and such security as the Council think fit. Even if they do not themselves lend money, County Councils may guarantee advances made to the Credit Bank from other sources. The credit of a County Council being first-class security, this provision should prove quite as useful in practise as the one enabling the Councils to advance money.

The recognition of the principle of credit banking in an Act of Parliament, added to the experience of Continental countries extending over half a century, during which the system has been thoroughly tested, should be a sufficient gurantee of its soundness and utility, and it may with confidence be expected that the spreading of information on the subject will be accompanied by a steady increase in the number of Credit Banks, which, wherever established, have been attended with such signal success.

Note.—This Leaflet has been prepared with special reference to operations under the Small Holdings and Allotments Act 1907, and is therefore intended for England and Wales only. At the same time, it may be said that the Friendly Societies and the Industrial and Provident Societies' Acts apply also to Scotland, and the Leaflet therefore contains information of interest to Scotland as well as to England and Wales.

NOTES ON DRY-FARMING.*

BY WILLIAM M. JARDINE,
Agronomist in Charge of Experiments with Dry-Land Cereals, Grain Investigations.

(From the *U. S. Department of Agriculture, Bureau of Plant Industry*, Circular No. 10, June 12, 1908.)

DRY-LAND AGRICULTURE IN MONTANA.

For the past three years the Montana Agricultural Experiment Station, in co-operation with certain railroad systems, has been conducting experiments in dry-land agriculture in various sections of the State. One of the stations is located near Forsythe, in the Yellowstone Valley, about 100 miles east of Billings. I visited this station on my way to Bozeman and found there some very interesting developments. Up to the present time this particular section of Montana has been devoted almost entirely to grazing. However, as a result of the two crops harvested on this experimental farm, many of the ranchers are now either selling out to prospective farmers or have begun farming themselves.

The yields so far obtained there have been most satisfactory. Turkey Red wheat last year produced 58 bushels to the acre, while a number of other winter varieties yielded above 40 bushels. As much as two tons of alfalfa hay has been

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* The observatio contained in this paper are abstracted from a Progress Report made during April of this year by Mr. Jardine, relating to farming in the arid sections of Montana, Utah, and Coloardo. Mr. Jardine has had a long experience in arid farming in Utah from both a scientific and a practical standpoint. His bulletin on Arid Farming Investigations (No. 100 of the Utah Agricultural Experiment Station) is one of the most valuable yet issued on this subject.—B. T. Galloway, *Physiologist and Pathologist, and Chief of Bureau.* 44195—C rc. 10-08.

harvested per acre; also 250 bushels of potatoes, 69 bushels of oats, and other hardy crops in equally large quantities.

The altitude of this station is between 2,000 feet, and the climate is much milder than of the western Dakotas. The average annual precipitation is between 13 and 15 inches. Last year, when the yields above mentioned were secured, there was little more than 13 inches of rainfall, 6 to 7 inches of which came during the growing season,

There is every indication that a large percentage of the tillable land of eastern Montana heretofore grazed will be brought under cultivation within the next few years. Each month new settlers are moving into this country.

My chief purpose in visiting Montana at this time was to begin work on the Fergus Country sub-station, recently established. The first crops are to be seeded this spring, but owing to the lateness of the season it was impossible for me to accomplish anything by visiting the station itself; hence, I did not go farther than Bozeman, Mont., where I met Professor Atkinson and Mr. Nelson, the two men in charge of the work. Mr. J. S. Cole, recently appointed in the Office of Dry-Land Agriculture Investigations, accompanied me and remained in Montana to look after the spring planting. Our work will be thoroughly established there this spring. We are planting this year in plats and in the nursery a hundred or more varieties of spring grains, and hope to secure considerable information that can be used immediately to good advantage by the farmers, as well as to accumulate data of value for the further and permanent improvement of crops for this section.

The principal grain crop now grown here is wheat. The two main varieties are Turkey Red winter wheat and Kubanka durum spring wheat. The winter wheat is preferable, as it yields 10 to 20 bushels more per acre than the best spring wheat known. Various crops are being introduced this year, looking toward the elimination of the one-crop system of farming by substituting a variety of crops that can be grown to advantage in rotation.

PLOUGHING WITH GASOLINE TRACTION ENGINES.

While in Montana I had an opportunity to observe for the first time a gasoline traction engine in operation. A 22-horsepower outfit was at work ploughing up sod land on the open prairie. I spent one day following this engine in order to collect reliable data on its performance. From the information obtained at this time, together with that previously secured from reliable men who had had experience with gasoline engines with ploughing, I am convinced that its success is practically assured. The gasoline engine is quite simple in its mechanism and is easily handled, only two men being required to operate both engine and ploughs.

This outfit had been running for ten days, and had averaged during that time a little more than 25 acres a day on heavy sod, ploughing to a depth of 4 inches and turning it over in good shape. The cost, including labour, was about 80 cents an acre. The two young men operating the engine were inexperienced hands, and yet everything seemed to be moving smoothly. They informed me that they had thus far met with no serious delays on account of breakages. The contract price for breaking sod land in Montana varies from $4 to $5 per acre. It would require twenty-five horses and five men at a cost of not less than $3·50 to $4·50 per acre, to do the same amount of work per day that these two young men were doing with their engine.

The gasoline-engine proposition for ploughing and other farming operations is entirely feasible where farming is done on a large scale, but it would not be practicable for the smaller farmer to own and operate an outfit. However, a number of small farmers could join together in the purchase of an engine without involving themselves as heavily as by purchasing the horses necessary to do the same amount of work. This method is followed in the West in buying thrashing outfits and is found thoroughly practicable.

If it is possible to produce crops at a cost of $2 to $4 less per acre by the use of gasoline engines on our dry farms this method should be adopted. The saving would be remarkable, especially where the average yield of wheat per acre probably does not exceed fifteen bushels. Some twenty of these ploughing outfits have been placed in Montana this year. In my judgment the gasoline ploughing outfit is here to stay and will aid materially in the cheap production of farm crops on our dry lands.

DRY-LAND AGRICULTURE IN UTAH.

At Logan, Utah, I spent one day at the Agricultural Experiment Station and two days visiting among the dry farmers of the Bear River Valley of northern Utah and the Malad Valley of southern Idaho. These two valleys offer splendid opportunities to study dry-land farming where it has been practised for the last forty years under an annual rainfall of less than 13 inches, with an average of less than 5 inches during the growing season.

Generally speaking, the farming methods in this region are not above the average. Very frequently the best of farmers crop their land twice with one ploughing, and only occasionally do they rotate their crops or summer fallow their fields. Most of them consider that they can make at least a good living if they can be sure of 15 bushels of wheat per acre each year, as they figure that it does not cost them more than $4 an acre to produce a crop.

At Nephi, Utah, where we are co-operating with the Utah Agricultural Experiment Station this year, we are doing more extensive work with dryland cereals than at any other point. Mr. F. D. Farrel is in charge of this farm and is much interested in the work. We have planted at this station about all the varieties known to be at all worth while, and hope to obtain much useful information here. Rust epidemics and insect pests are practically unknown in this area. The only adverse condition with which we have to deal is drought; hence, any variety found to be superior in yielding capacity will indicate its ability for maximum production with a minimum amount of moisture. We have our work so arranged as to be able to watch the development of individual plants, and thus secure data of a very reliable nature looking toward the development of new types of superior quality.

DRY-LAND AGRICULTURE IN COLORADO.

In Colorado I visited the dry farm of Mr. E. R. Parsons, located 23 miles south-east of Denver, on the Colorado and Southern Railroad, near Parkers. Mr. Parsons is a very intelligent Englishman. He came to this country from the Transvaal, South Africa, where he had considerable experience in dry farming. He has a commercial orchard, which was set out in 1895. Mr. Parsons is now independently wealthy, and I am informed that he has made nearly all of his money out of his dry farm. He says that the success obtained in producing crops without irrigation in eastern Colorado will depend on the man.

Mr. Parsons has been living on this farm since 1886, and is therefore familiar with the whole of eastern Colorado and thoroughly competent to speak intelligently on the conditions obtaining in this part of the Great Plains. He states positively (and his farm will bear him out in his statements) that there is no sane reason why the average farmer cannot succeed on the plains of Colorado if he will farm intelligently.

The orchard is planted on land sloping to the north and west. The soil is a very heavy clay. It is 300 to 500 feet to water. The annual precipitation averages about 13 to 15 inches. Last year the precipitation was 13 inches. Five to seven acres are planted to cherry trees of the varieties Montmorency and Morrello, which are now ten years old, the first-named being the most hardy and drought resistant, and hence the preferable variety. Mr. Parsons has secured from this orchard on an average one crate of cherries to the tree during the past three years, except last year, when they were frozen down at the time all fruit was frozen in Colorado. He has about 120 trees planted to the acre, and receives $3 a crate for his cherries delivered in Denver. He also has about four acres of apple trees now bearing fruit. The 10-year-old trees are bearing about four bushels to the tree. He has more than 100 trees to the acre, but has since decided that this is too close planting, and in his new orchard, recently set out, trees are placed about 40 feet apart, or 80 trees to the acre. The Jonathan, Rome Beauty, and Ben Davis seem to be the most profitable varieties to grow in this particular locality.

In addition to his cherry and apple orchard, Mr. Parsons has four acres of currant bushes of the London Market variety. These are planted 8 feet apart each way. During the past three seasons he has taken from each of the 5-year-old bushes one gallon of currants, realizing 15 cents per gallon. In 1906 Mr. Parsons realized in cash from his orchard $1,500. This was in addition to fruit necessary for home consumption and generous distribution among friends.

Considerable alfalfa, corn, and wheat are also grown by Mr. Parsons; in fact, everything necessary to feed his animals. His corncrib was filled with excellent corn, samples of which I brought to the Department. This last winter he fattened 100 head of beef steers on alfalfa grown on his farm without irrigation. He has harvested each year from 1½ to 2½ tons of excellent hay to the acre. Turkey Red wheat yielded him last year a little more than 40 bushels to the acre.

During 1907 Mr. Parsons produced 40 bushels of corn to the acre on sod land that was ploughed 9 inches deep. This is a little contrary to the general belief as to what can be done on sod land. The general practice is to plough sod as shallowly as possible, in order that it may rot the better during the summer. Mr. Parsons, however, in his twenty years' experience on a dry-land farm has obtained far better results by ploughing the sod deeply,

Early Ohio potatoes have been found most profitable for his section. The best yields are always obtained from this variety, planted about April 1.

Mr. Parsons attributes his success to the thoroughness with which he cultivates his soil. He never ploughs his land less than 9 to 12 inches deep, whether it be sod or otherwise. This is usually done with a hand plough pulled by four large horses. Mr. Parsons does not approve of disk plough now so commonly used by our dry-land farmers. In this respect I heartily agree with him. Sod land especially should be turned over completely, in order that the sod may rapidly and fully decay, and at the same time serve as a blanket to retain the moisture that has fallen and accumulated in the soil previous to ploughing. This cannot be accomplished with a disk plough. The disk twists and breaks up the sod, leaving it in clods, thus presenting a very loose and uneven surface, which permits a free circulation of air and thus favours rapid evaporation of moisture from the ploughed land. On the other hand, where the sod is turned over completely the moisture is retained during the entire summer, thus enabling the farmer to prepare a favourable seed bed for planting to winter grain—the crop that now predominates in eastern Colorado.

In this connection I may state that one of the greatest mistakes new settlers are making in breaking up their land on the plains is in use of the disk plough instead of the moldboard breaking plough. This is probably due to the fact that with the disk plough, which is of somewhat lighter draft, the farmer can plough up his land more easily and more rapidly. The results obtained from this hasty method are, however, fully evident at harvest time. In my judgment the use of the disk plough should be discouraged.

Work at the Akron sub-station, Colorado, is progressing nicely. Although the land was broken up for the first time last June, it is now in fairly good condition. Winter wheat seeded in September and as late as November came through the winter in good condition. In most places there is a stand of 95 to 100 per cent. About half an inch of rain fell there April 16. This practically insured a good stand of spring grain. At the time of my visit, April 23, most of the spring grain and all the winter wheat were up and showing a strong growth.

From Akron along the Burlington Railroad en route for St. Louis I observed many excellent fields of winter wheat. Considerable farming is being done in this territory this year, and while the precipitation since 1st February has been very light, the crops look promising, and those farmers with whom I had an opportunity to talk are very confident that this year will be a successful one

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MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 9th June, 1909.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine	85s a 90s
Zanzibar & Hepatic ,,	Common to good	40s a 85s
ARROWROOT (Natal) lb.	Fair to fine	2⅞d a 4d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair ..	£6 15s a £6 17s 6d
Bombay bleached ,,	Fair to good	£7 10s a £7 12s 6d
,, unbleached ,,	Dark to good genuine ..	£5 15s a £6 10s
Madagascar ,,	Dark to good palish	£6 10s a £6 17s 6d
CAMPHOR, Japan ,,	Refined	1s 6½d a 1s 9d
China ,,	Fair average quality ..	142s 6d
CARDAMOMS, Tuticorin	Good to fine bold	1s 9d a 2s 2d
	Middling lean	1s 6d a 1s 8d
Tellicherry	Good to fine bold ..	1s 9d a 2s
	Brownish	1s 3d a 1s 7d
Mangalore ,,	Med brown to fair bold	2s 2d a 3s 2d
Ceylon. Mysore ,,	Small fair to fine plump	1s 3d a 3s
Malabar	Fair to good ..	1s 4d a 1s 6d
Seeds, E. I. & Ceylon ,,	Fair to good	1s 8d a 1s 9d
Ceylon Long Wild ,,	Shelly to good ..	6d a 1s 6d
CASTOR OIL, Calcutta ,,	1sts and 2nds ..	2¾d
CHILLIES, Zanzibar cwt.	Dull to fine bright ...	35s a 40s
CINCHONA BARK.– lb.		
Ceylon	Crown, Renewed	3⅜d a 7d
	Org. Stem	2d a 6d
	Red Org. Stem	1⅜d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts per lb.	Good to fine quill	10d a 1s 4d
2nds	,, ,,	9d a 1s 2d
3rds	,, ,,	7½d a 11½d
4ths	,, ,,	6½d a 9½d
Chips, &c..	Fair to fine bold	2⅝d a 3⅛d
CLOVES, Penang lb.	Dull to fine bright pkd.	1s a 1s 1d
Amboyna ..	Dull to fine	8d a 9d
Ceylon ..	,, ,,	7½d a 9d
Zanzibar	Fair and fine bright	4⅜d a 4¾d
Stems ..	Fair	1¼d
COFFEE		
Ceylon Plantation cwt.	Medium to Bold	nominal
Native	Good ordinary	nominal
Liberian ,,	Fair to bold	43s a 55s
COCOA, Ceylon Plant. ,,	Special Marks	73s a 83s 6d
	Red to good	65s a 72s 6d
Native Estate ,,	Ordinary to red	41s a 60s
Java and Celebes ,,	Small to good red	30s a 85s
COLOMBO ROOT ,,	Middling to good	15s a 17s 6d
CROTON SEEDS, sift. cwt.	Dull to fair	30s a 35s
CUBEBS ,, ,,	Ord. stalky to good	80s a 90s
GINGER, Bengal, rough,,	Fair	27s
Calicut, Cut A ,,	Small to fine bold	55s a 85s
B & C ,,	Small and medium	52s a 55s
Cochin Rough ,,	Common to fine bold	38s a 42s
	Small and D's	37s 6d
Japan ,,	Unsplit	32s
GUM AMMONIACUM ,,	Sm. blocky to fair clean	25s a 60s nom.
ANIMI, Zanzibar	Pale and amber, str. srts.	£16 a £18
	,, ,, little red	£13 a £15
	Bean and Pea size ditto	75s a £12
	Fair to good red sorts	£9 a £13 10s
	Med. & bold glassy sorts	£7 a £9 5s
Madagascar ,,	Fair to good palish ...	£4 a £8 15s
	,, ,, red ...	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	25s a 32s 6d nom.
Turkey sorts ,,		27s 6d a 47s 6d
Ghatti ,,	Sorts to fine pale ...	20s a 42s 6d nom.
Kurrachee ,,	Reddish to good pale ...	20s a 30s ,,
Madras ,,	Dark to fine pale ...	15s a 25s ,,
ASSAFOETIDA ,,	Clean fr. to gd. almonds	85s a 100s
	com. stony to good block	25s a 75s
KINO	Fair to fine bright	6d a 9d
MYRRH, picked cwt	Fair to fine pale	80s a 115s
Aden sorts ,,	Middling to good	55s a 70s
OLIBANUM, drop ,,	Good to fine white	40s a 60s
	Middling to fair	25s a 35s
pickings ,,	Low to good pale	10s a 20s
siftings ,,	Slightly foul to fine	13s a 15s
INDIA RUBBER lb.	Fine Para bis. & sheets	5s 4d
	,, Ceara ,, ,,	5s 7d
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine..	5s 6d a 6s
	Fine Block ..	6s 1d
	Scrap fair to fine ..	4s 9d a 5s 2d
Assam	Plantation	4s 8d
	Fair II to ord. red No. 1	3s 8d a 4s 2d
Rangoon	,, ,,	2s 8d a 3s 6d

	QUALITY.	QUOTATIONS.
INDIARUBBER.*(Contd.)*		
Borneo	Common to good	1s a 5s
Java	Good to fine red ..	2s a 3s 9d
Penang	Low white to prime red	1s 6d a 2s 10d
Mozambique	Fair to fine red Ball ...	3s 3d a 4s 7d
	Sausage, fair to good ..	3s 3d a 4s 6d
Nyassaland	Fair to fine ball ...	3s 4d a 4s 3d
Madagascar	Fr to fine pinky & white	2s 10d a 3s 8d
	Majunga & blk coated ..	2s 3d a 2s 9d
	Niggers, low to good ..	1s 6d a 3s 2d
New Guinea	Ordinary to fine ball ..	3s 2d a 4s 6d nom
INDIGO, E.I. Bengal	Shipping mid to gd violet	3s 5d a 3s 10d
	Consuming mid. to gd.	3s 1d a 3s 4d
	Ordinary to middling	2s 9d a 3s
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 3d a 2s 6d
	Low to ordinary	1s 6d a 2s 2d
	Mid. to fine Madras	1s 5d a 2s 4d
MACE, Bombay & Penang per lb.	Pale reddish to fine	1s 11d a 2s 4d
	Ordinary to fair	1s 8d a 1s 10d
Java	,, ,, good pale	1s 7d a 2s 1d
Bombay	Wild	5d
MYRABOLANES, cwt	UG and Coconada	5s a 5s 6d
Bombay ,,	Jubblepore	4s 9d a 6s 9d
	Bhimlies	4s 9d a 7s
	Rhajpore, &c.	4s 6d a 6s 3d
Bengal ,,	Calcutta	5s a 5s 6d
NUTMEGS— lb.	64's to 57's	1s 3d a 1s 6d
Bombay & Penang ,,	110's to 65's	4¾d a 1s 2d
	160's to 115's	4d a 4½d
NUTS, ARECA cwt.	Ordinary to fair fresh	12s a 14s
NUX VOMICA, Cochin per cwt.	Ordinary to good	9s a 11s 6d
Bengal	,, ,,	6s a 6s 6d
Madras	,, ,,	6s 3d a 8s
OIL OF ANISEED ,,	Fair merchantable	4s 5d
CASSIA ,,	According to analysis	4s a 4s 4d
LEMONGRASS ,,	Good flavour & colour	2d a 2¼d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2¼d a 1s
CITRONELLE ,,	Bright & good flavour	1s a 1s 1d
ORCHELLA WEED—cwt		
Ceylon ,,	Mid. to fine not woody...	10s a 12s
Madagascar ,,	Fair ...	10s
		,,
PEPPER—(Black) lb.		
Alleppee & Tellicherry	Fair ..	3¼d
Ceylon	,, to fine bold heavy ..	3¼d a 4d
Singapore ...	,, ...	3¼d
Acheen & W. C. Penang	Dull to fine	3d a 3½d
(White) Singapore ,,	Fair to fine	5½d a 8d
Siam ,,	Fair	5d
Penang ,,	Fair	4½d
PLUMBAGO, lump cwt.	Fair to fine bright bold	—
	Middling to good small	—
chips	Dull to fine bright ..	—
dust	Ordinary to fine bright	—
SAGO, Pearl, large ..	Dull to fine .. .	15s a 16s 6d
medium .	,, ,,	14s a 15s
small ..	,, ,,	11s 6d a 13s 6d
SEEDLAC cwt.	Ordinary to gd. soluble	50s a 90s nom.
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 7d
	Fair greenish	3¼d a 4½d
	Common speckyand small	1½d a 2½d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold ..	25s a 90s nom.
Bombay ,,	,, ..	30s a 90s
Mergui ,,	,, ,, ...	£6 2s 6d a £7 10s
Manilla ,,	Fair to good ..	£5 15s a £9 5s
Banda ,,	Sorts	25s a 30s nom.
TAMARINDS, Calcutta..	Mid. to fine bl'k not stony	11s a 13s
per cwt. Madras	Stony and inferior ..	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold ..	12s 6d a 26s
	Pickings ..	6s a 24s
TURMERIC, Bengal cwt.	Fair .	18s
Madras ,,	Finger fair to fine bold	18s a 20s
Do. ,,	Bulbs [bright	14s a 16s
Cochin ,,	Finger .	15s
	Bulbs ..	13s
VANILLOES— lb.		
Mauritius .. 1sts	Gd crystallized 3½ a 8½ in	9s a 16s
Madagascar ... 2nds	Foxy & reddish 3½ a ,,	8s 3d a 12s
Seychelles ... 3rds	Lean and inferior ...	8s 3d a 8s 9d
VERMILLION ..	Fine, pure, bright .	2s 11d
WAX, Japan, squares	Good white hard ...	46s 6d

THE SUPPLEMENT TO THE

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THE COCONUT STEM DISEASE.

EXHAUSTIVE INVESTIGATIONS BY MR. PETCH.

LECTURE AT THE AGRICULTURAL SOCIETY MEETING.

At last meeting of the Ceylon Agricultural Society Mr. T Petch, the Government Mycologist, gave an interesting and instructive, though somewhat technical, lecture on the Coconut Stem Disease.

He started by mentioning the investigations he had made in connection with the

PREPARATION OF COIR

and said he had taken samples of the husks from Mirigama, where they had been soaking for about three weeks, from a river at Weligama, and from pools near the shore. Those husks were examined for the fungus of tho coconut disease. In the case of Mirigama he found numerous fungi, but no *Thielaviopsis Ethaceticus.* At Weligama on the river he found a little *Thielaviopsis* in the husks, but not sufficient to account for their decay; and in the pools near the shore at Weligama there was a little more *Thielaviopsis*, but again not sufficient to account for decay. It was evident from the condition of the husks and the amount of fungus on them that whatever fungi were found on the decaying husks had grown there before they were placed in the water.

The water was tested as well as samples of husks. It was allowed to settle and the sediment was sown indiscriminately on sterilised plates. In that way he could get growths of the coconut disease fungus in the water from the coir mills and in the water from the pools on the shore; but he could not get it from the water taken from the river at Weligama, because there was so much sulphuretted hydrogen in it that it gave a thick deposit of sulphur and nothing would grow. Taking it all round, it was evident that the small amount of fungus spores found on the coir grew there before the husks were placed in the water and that the decomposition of the coconut husks was not effected by the fungi at all. Another interesting point which came out in the investigations, and which was worth remembering when considering the question of the

APPLICATION OF SALT TO COCONUTS,

was that the water from Mirigama inland was salter than the water in the pools on the shore at Weligama. The difference was :—Mirigama, ·13 per cent., Weligama ·08 per cent, ·05 more.

The next question was :

HOW FAR THE FUNGUS WOULD GROW ON DEAD COCONUT TISSUE ?

Of course they all knew that the leaves and husks of coconuts were left lying about the estates or were used in manuring; and if the fungus would grow well on the tissue, it would be dangerous to leave them about. His investigations showed, however, that if they sowed the spores of the fungus on the white tissue inside the fresh husks and leaf stalks, they got a very poor growth. If they took the brown husk and tried to grow the fungus on the husk they got no fungus at all. The leaves followed the same rule. If they took the green leaf, they would get a small amount of the fungus to grow. On the interior of the stem the fungus grew in abundance. That was practically the only tissue of the coconut on which it would grow, that was, grow to any dangerous extent. If they took the top of the stem, *i.e.*, the cabbage, and cut sections of that, and sowed the spores of the fungus on it it absolutely refused to grow. That explained the fact that when the stem of a coconut was hollowed out by the disease, the cabbage was not touched. The explanation seemed to be that the fungus would only grow on tissues which contained a fair quantity of sugar. There was sugar in the coconut stem, in the lower part, the white part, but there was none at all in the coconut

husk or the leaf stalk after it had fallen, or the tissues in the bud. The fungus grew, as he said, on the tissues of the coconut which contained sugar. As a matter of fact they had to grow it in a solution of sugar before they could get it to germinate at all. He had there a flask in which was some of the fungus in a solution of sugar.

(The flask was handed round for the inspection of the Chairman and members.)

If they sowed the spores in pure water, or in ordinary tap water, they would not grow at all. Another point about the growth was that it would grow very much better in darkness than in light. Many fungi would grow better in darkness than in light, but they produced spores only in the light. *Thielaviopsis* formed a very much greater weight of spores in the darkness than in the light. In about a week they got 50 per cent. greater growth in darkness than in light. They could not get the spores to germinate in the absence of oxygen.

The question as to

HOW LONG SPORES WOULD RETAIN THEIR GERMINATING CAPACITY

was rather an important one, but the experiments were not altogether finished. In one experiment spores were distributed over a filter paper or rather a series of about a dozen filter papers; then the papers were exposed under different conditions. Two sets were dried in a desiccator and two sets by exposure to the air; one of each was placed in the sunlight and the other left in the dark. Calling the air dried spores damp, as they possibly would be, the damp spores were killed by the sunlight of about three hours a day in less than a fortnight, whereas the perfectly dried spores exposed to the sunlight retained their vitality for ten weeks. If the spores were kept in the dark, they retained their germinative capacity longer. An experiment was begun at the end of November last year, and the spores kept in the dark were not dead yet; so there was a great difference in the germination of the spores kept in darkness from those exposed to sunlight. That, on estates, might be an important point. He had taken black patches from the trees and tested the spores in the black patches. Of course there was no knowing how long the spores had been on the tree; they might have been there two months or two years. In patches obtained from Batticaloa he did not get a single germination in three cases, and in the case of patches from Kalutara he got one germination out of three. It might, therefore, be taken that in cases of ordinary estates where the sunlight reached the trees most of the spores were quickly killed by the sunshine. The other experiment he referred to was to find out how long the spores would take to die if they were dried in the sunlight. This had not yet been determined.

THE EFFECT OF VARIOUS CHEMICALS ON THE FUNGUS

was tried. Copper sulphate was recommended last year, and carbolic acid was suggested, as well as various other agents. In testing that question the fungus spores were placed in a flask, in a solution in which they would grow, and then a certain percentage of the chemical was added. A chemical had not a poisonous effect unless it would stop the growth of the fungus with about one per cent. If they had to use five per cent. there was no poisonous action. Potassium nitrate was recommended, but the fungus would grow in 12 per cent. of potassium nitrate and was stopped by 13, so they could put that out as a fungicide. Kainit was strongly recommended. The fungus would grow in a solution of 13 per cent. It stopped at 14 per cent. so that the fungicidal action in that case was absolutely *nil*. Common salt, that was the ordinary dry cooking salt, stopped the growth of the fungus at seven per cent. If they took sodium chloride instead of common salt, the growth stopped at six per cent., a slight improvement. It was thought that the magnesium salts might have some action and so magnesium sulphate was tried. He found that the fungus would grow in a solution containing 25 per cent. of magnesium sulphate, so he stopped that and did not go any further. By the rate it was growing it would possibly have grown in a solution containing 50 per cent. Chloride ought to have been tried, but he had not got it. Caustic potash and caustic soda both stopped the growth as soon as the solution became alkaline. This fungus would grow in acid solution, but not at all in alkali solution. Tannic acid gave a peculiar result, the growth of the fungus being stopped by ·3 per cent. of tannic acid. It was thought that that might explain the fact that the fungus did not grow in the cabbage of the coconut, but there was no tannic acid even in the cabbage.

With regard to the poisons, copper sulphate stopped the growth of the fungus at ·04 per cent., 4 parts in 10,000, whereas the other chemical recommended, carbolic acid, only stopped the growth at ·1 per cent., one part in a thousand, so that as far as stopping the growth was concerned carbolic acid was very much behind copper sulphate, but it had a great advantage in one respect, in that it killed the spores very much sooner than copper sulphate.

The figures he had been giving them related to the stoppage of the growth of the fungus, but the

ABSOLUTE KILLING OF THE SPORES

was quite a different matter. They might find that the spores would not grow in a solution containing so much per cent. of tannic acid; but if they took them out of that solution, and put them in another without tannic acid then they would grow. Tannic acid did not kill them; it simply stopped the growth. ·1 per cent. carbolic acid did not kill the spores, but it stopped their growth. When they tried to find what percentage killed the spores, they discovered that one per cent. of carbolic absolutely killed them in a day, whereas one per cent. of copper sulphate would not kill them in a month. In fact he had spores in a five per cent. copper sulphate solution which were not dead in seven weeks; so that the best thing for killing the spores was carbolic acid. Unfortunately they could not use it because it could not be applied with safety to the tree.

It was evident that the

EFFECT OF THE DISEASE

was not so great as was formerly stated. He did not think it could now be said that the tree died in three or four, or even five years.

Mr. Petch then produced some photographs, which were handed round for inspection.

The first, he said, was of a tree which had three bleeding spots about half-way up. It had been in that condition for two years. It had over a dozen branches of nuts and the crop was as good as ever. It stood the gale of last week. Another was of a tree which was inoculated in September, 1907—the tree, therefore, being about 20 months from inoculation. The bleeding spot on that was not more than two inches broad and not more than half-an-inch wide, in fact he had to mark it with a card at the base of the stem or it would not have been seen in the photograph. The result on the crop had not been shown at all.

The third photograph gave the kind of tree which died. As they would see, it was planted among areca nuts, breadfruit, and coconuts, at distances of about 8 feet. The tree was probably ten or eleven years old and from the position of the spot it might have been infected about four years. The tree was planted under the dense shade of other coconut trees, and trees planted in such circumstances certainly did die.

The fourth photograph showed an old scar with a recent bleeding patch just above it. The scar was at the base of the tree. The tree was about 40 or 50 years old, so it was impossible to guess the age of the scar at all.

The CHAIRMAN (H E the Acting Governor) :—Do you find that when you cure a tree it shows any increased vitality?

Mr PETCH :—I cannot say that has been observed, but I should expect it to show an increased crop. Statistics for export do not give any support to the supposition that the crops diminish because of the disease. There is one thing I would like to correct. It was reported in 1906 that an estate was badly affected and that the crop had been diminished. As a matter of fact, the estate returns showed that there had been a regularly increased crop.

In answer to another question,

Mr PETCH—said that when he said there was no sugar in the cabbage, or in the leaf, he meant there was no sugar as such. There was sugar bound up with other things, which might be set free, but there was no

FREE SUGAR FOR THE FUNGUS TO GROW UPON.

Mr. LUSHINGTON—said that Mr. Petch contrasted Batticaloa and Kalutara trees and mentioned particularly that sugar was very essential for developing the disease. Had he found in his experiments that there was very much more sugar in the coconuts in districts like Kalutara than in the dry districts like Batticaloa? He mentioned it because all toddy drawing was always done in the western districts, and if they went north, there was very much less toddy, he believed.

Mr. PETCH—said they only had analyses from that (the Colombo) side of the island so he could not make a comparison. They had no analyses from the Batticaloa side, but he would attribute the absence of the disease on the Batticaloa side to the fact that it was drier.

Mr. VANDERSTRAATEN—enquired if Mr. Petch had experimented with Cyllin or Jeyes' disinfectant.

Mr. PETCH—said he had not and added that he did not recommend the use of carbolic acid.

In answer to a further question—Mr PETCH said he had found the disease within about 4 feet of the cabbage. It was practically certain that the spores found in the pool were blown on to the husks from the trees.

Mr SHERIDAN PATTERSON:—Is there any use in washing the stems of trees with copper sulphate as a preventive?

Mr PETCH :—I hardly think the advantage is worth the cost.

Mr SHERIDAN PATTERSON :—I think it costs R2·50 to R3 an acre.

Mr PETCH :—In that case I should do it.

The discussion was closed by the CHAIRMAN who said:—I feel sure, gentlemen, that I shall be echoing your wishes if I express to Mr Petch the great obligation under which we feel ourselves for the most interesting discourse he has given.

COCONUT STEM DISEASE AND CROPS.

Marawila, June 13.

DEAR SIR,—Surely Mr. Petch ought to have known the habits of the coconut tree better than to state that stem disease has not affected crops. Mr. J D Vanderstraaten read a paper not long ago and said that the results of his dissections showed that the crops of three years are inside the stem of the tree. He should have told Mr. Petch that it was too soon for him to have drawn inferences. I must, however, state that my invariable experience has not been in accord with the conclusions drawn by Mr. Vanderstraaten as the result of his surgical investigations. Without exception, I have always found improvement in the appearance of the trees and in blossoms, 12 to 18 months after the application of manure. The resulting crops are gathered 12 months after that.—Yours faithfully,

B.

GROWTH OF RUBBER.

We are credibly informed that on a well-known estate in the Malay Peninsula 3,060 trees, planted 15 by 15 ft. apart, attained a girth of 18," 3 ft from the ground, in four years from the date of planting. This is about equal to the growth of the rubber on several of our more advanced estates. But what is most gratifying in connection with those trees is the fact that they produced, during the fifth year of their existence 7,629½ lb of rubber or an average per tree of 2·49 lb.—*British North Borneo Herald*, May 17.

BRASSOLIS ISTHMIA, A COCONUT PEST IN PANAMA.

A Lepidopterous Insect Highly Injurious to the Coconut.

The attention of coconut growers in these Islands is called to the following facts regarding the above insect, from a report of Mr Henry F Schultz, Horticulturist for the Canal Zone, Isthmus of Panama:—

Early in May, 1906, the majority of the coconut trees in the neighbourhood of Ancon were defoliated by the attacks of a carterpillar. Large trees, which had been bearing crops for a number of years, stood without a particle of foliage with their bare petioles and midribs resembling skeletons. Some had to be cut down, but the remainder recovered under the special care given them.

Later in the same year, about the middle of September, the caterpillars again appeared, although not in as large numbers as before, and began to strip the trees anew. All coconut trees were, therefore, sprayed with a strong solution of arsenate of lead, a most tedious and troublesome, although very effective, method of fighting these insects, in view of the height of the tree, which were mostly from 30 to 35 feet, Although torrential rains washed off the arsenate of lead after a few weeks, it stayed on long enough to kill all the insects on the trees which had received treatment.

This year the caterpillars made their appearance again in May. Apparently this is the time of year when the mature insects deposit their eggs freely on all coconut trees in the vicinity, for about the latter part of August thousands of their larvæ began to defoliate these palms again and were evidently determined not to leave a single leaf on the trees. However, one fact was noticed, viz., that the larvæ feed only at night and that they retire before the first rays of the sun into a tough web spun with pinnæ of the leaves, where frequently as many as 700 to 800 crowd together in one nest. The lower part of this, where the ends of the pinnæ meet, is left slightly open and the nest presents the appearance of a long narrow bag from 30 to 60 centimeters in length, according to the number of insects it contains. Frequently a tree will have two, three, or even four of these nests and some were found where the number of full-grown larvæ were estimated to be over 2,000. What even half of this number can do to a full-grown tree if their ravages are not speedily stopped can be imagined, especially if the fact is kept in mind that they attain the respectable size of 5 to 10 centimeters in length and have enormous appetites like most caterpillars.

A bearing coconut tree will thus be stripped of every inch of its foliage in a few nights and receive such a severe check in its growth that even with all due care in preventing the reappearance of the pest in following years, at least two or three crops of nuts will be lost, and it is no rare occurrence that a tree dies outright or becomes so weak that it cannot resist fungoid and other diseases, and gradually perishes.

After reaching maturity or when the supply of food gives out, the larva passes into the chrysalis stage, in which it remains twelve to sixteen days, and this is the time when the larvæ of an apparently dipterous insect help in the extermination of "Brassolis." It has been impossible to determine whethor the mature parasite deposits its eggs into the skin of the caterpillar or into the chrysalis, or whether its ova are introduced through the alimentary tract of the larvæ with its food. Dr. Darling, chief of the board of health laboratory at Ancon, has examined mature larvæ of "Brassolis" under a high-power microscope without finding any traces of parasitic ova in either the skin or the intestinal ducts. However, as only a small number were examined on account of lack of time, it is possible that the few specimens observed were not infected with parasites.

As the parasitic larvæ are not protected with a skin, which in the judgment of the writer would be tough enough to withstand the gastric juices of "Brassolis," the probability of cutaneous infection suggests itself. The destruction of "Brassolis" through its parasites seoms to be rapid, though the actual time cannot be given, as those in captivity seem to be free from infection.

As previously stated, the larvæ feed only at night and try to hide in their nests during the day, but this hiding becomes in reality a means of their being more easily detected and destroyed, for it is a great deal easier to cut down these nests than to spray the trees. However, this requires constant vigilance on the part of the grower, as in the groves where the tree tops frequently touch each other, the caterpillars can crawl from tree to tree.

The writer seems to believe that "Brassolis" is one of the most formidable enemies of the coconut grower if it is allowed to spread, and that every possible attention should be given to the immediate destruction of the larvæ at their first appearance.

The "Brassolis isthmia" has also been found on the following palms:—"Martinezia caryotaefolia," "Acrocomia solerocarpa," "Oreodoxa regia," "Oleracea," and two unidentified species of "Thrinax."

Any coconut growers who find that "Brassolis isthmia" has made its appearance in these Islands are requested to advise the Bureau of Agriculture at once, giving all the details possible with reference to its ravages in their vicinity.—*Philippine Agricultural Review*, for April, 1909.

[Have any growers come across this pest, or anything similar, in Ceylon estates? Perhaps the Government Entomologist, Mr. Green, will be able to say if the insect is known in Ceylon. It is not mentioned in his list of pests of the coconut palm given on p. 839 of the *Tropical Agriculturist* for July, 1906.]

THE NEW TAPPING SYSTEM.

FRESH SCIENTIFIC INVESTIGATION WANTED.

When the new tapping system was first announced, it was (as is stated again in a special article in the London *Times* of May 21st) fortified by a favourable report from Dr. Willis, Director of the Botanic Gardens. That was in November last year, eight months ago; but on the recommendation given by Dr. Willis there was not anything like full scientific testimony to its effects; and even if it had been given, it might have been open to the criticism that the system had not been in use sufficiently long for the chief points about it to receive authoritative commendation. For a few months all went swimmingly and a large number of Ceylon rubber estates paid their R500, which, it may be remembered, was to be repaid to the estate experimenting if the method failed in the advantages claimed; we heard, not long ago, of a cheque for as much as R18,000 being signed by a prominent visiting agent on behalf of some 36 estates. But since then a defect was brought to our notice which was said to have arisen from the employment of the new system, namely, the formation of coagulated rubber pads between the cortex and the cambium which would eventually rot whole trees. Following on this discovery we understand that a number of estates under one agency were instructed to give up the new tapping system and return to the old use of the knife and the paring that follows it. There have not been many expressions of opinion in favour of the system since the announcement of the discovery; and no doubt those who have been satisfied with their first results of pricking, &c., have not wished to commit themselves before they had endeavoured to trace any similar phenomenon on their own property. Now, however, we have a letter from a well-known Ratnapura planter, "P. D. G.," who comes forward with a thoroughly practical suggestion, pointing out that it is in vain to argue the merits or demerits of the Northway system, from tho striking discoveries which received prominence in our columns. On Deviturai estate itself the thing is demonstrated, for those who wish to pay the fee, in a thoroughly practical way by Mr Northway himself, even to the showing of sections of the bark bearing the results of the system on trees previously tapped, and in view of the strong faith that is felt in the system by the true believers we cordially support the suggestion that it is time the scientific department at Peradeniya went thoroughly into the system and made investigations of a much wider and more exhaustive naturo than Dr Willis, as far as we know, made before he went home on leave. If Messrs R H Lock, Acting Director, and T Petch, the Mycologist, could meet Messrs Northway, W Forsythe and C O Macadam, a very valuable report might be obtained. This report, however, should not be confined, we consider, to the show place of the system, Deviturai Estate; but should also include a visit to some properties where rubber pads have been discovered under the bark. Then if those instances were clearly traced to faulty work, it is possible the Agency in question would, on obtaining fuller knowledge, revert to the new system—? On the other hand it is equally possible that the scientists from Peradeniya might, on examining the trees at Deviturai, say that even there they had not been long enough subject to the "new" tapping, to enable a verdict that might be depended on by the rubber planting community at large for a long series of years to come. At any rate what "P. D. G." says—that it would be aggravating six months hence to realise the loss of time incurred in arriving at the settlement of the question if nothing definite were to be done now—is perfectly sound; and on this score, if on no other, we trust Messrs. Lock and Petch will, on their own initiative, or that of the present Executive Government, arrange the proposed visit at an early date and allow the utmost possible time they can spare to the study of a question of so great importance to the second largest section of European planters in the island.

P. D. G.'s LETTER.

Ratnapura, June 5th.

Dear Sir,—It would seem that we are to drift along, with the advancement of the present season, vainly arguing the merits and demerits of the Northway System in view of one or two instances of tapping which appear to have shown rather poor results with damage to the tree. Any one, who has visited Deviturai estate and observed the thoroughly practical manner in which Mr. Northway demonstrates his system both in the actual process of tapping and in sections of the bark as showing the after-effects of the system on trees previously tapped, cannot but be convinced of the efficiency of the system and that at the least possible expense to the tree. We have a scientific department to which to apply to for guidance and I would suggest that Messrs. Lock and Petch be asked to meet, say, Messrs. Northway, W Forsythe, and/or J P Anderson, and C O Macadam who might be afforded opportunities of reporting upon those trees on different properties where the system has been reported to have failed, and when such questions as the blistering of the bark with the exudation of rubber might be traced to a cause. I cannot but believe that those instances alluded to above will eventually be traced to faulty work, when it would indeed be aggravating to realise, at the end of 6 months, the loss of time incurred in arriving at a settlement of the question. —Yours faithfully,

P. D. G

SUB-CORTICAL RUBBER PADS AND THE NORTHWAY SYSTEM.

The following letter from the inventor of the new tapping system is illuminating, with reference to specimens of bark and rubber pad sent to him and reported to be the result of using his method of tapping. We cannot quite follow the first case: Mr. Northway first says the pricker did not go through the bark at all, and then says it went through the green bark; but he does not say whether the pad

was formed under the green or under the dry portion of the bark surface. The second case is a curiosity; the mark of the pricker was found in a pad already formed. As Mr. Northway surely does not mean to tell us that these rubber pads are formed of themselves—like sub-cutaneous Hevean boils!—we would like to know whether his inference was that a knife must already have been at work?—or had a pricker been over the same bit of bark before? In conclusion, does Mr. Northway, by his remarks on the third piece of bark, mean that the use of the pricker is not to be recommended for older, but *only* for young trees with easily pierced bark?—the pricker being used always as lightly as possible.

MR. NORTHWAY ON FAULTY TAPPING BY HIS SYSTEM.

Explanation of the Rubber Pads.

Deviturai, Ambalangoda, June 6th.

Sir,—I received three pieces of bark from an estate—two with pads said to be caused by my system. You can form your own opinion if you simply look between the pad and bark. In one case you will see the pricker has not gone through the bark at all! Why? Because the bark was dead and dry and the pricker could not go through. It has gone through the green bark on both sides of the dry.

In the other piece of bark, the pricker mark is seen on the outside, and can be distinctly traced to inside the pad itself. This again proves the pad was there at the time of pricking or the pricker marks could not be *inside it*.

The other piece of bark, showing pricker marks, is quite natural and will invariably be seen shortly after any pricking done with too much pressure, but in a few months will be completely covered. Now, judging from these bark samples, it would appear the trees have been cleaned months ahead, because it has a hard dry corky coat outside. I would not expect anything else but *failure* if I tried to work on such a surface.—Yours, &c.,

CHAS. NORTHWAY.

II.

Sunnycroft, Ruanwella, June 10th.

Dear Sir,—With reference to Mr. Northway's letter *re* pads of rubber under the bark of Hevea trees, as I am the person who sent him the pieces of bark mentioned and as his letter is somewhat misleading, I must ask you for a small space in your paper to correct it.

1st. In all the boils which I have seen caused by Mr. Northway's system the pad of rubber always lies between the rows of pricks inside the bark; and I have *never seen prick marks, on the inside of it* next the wood, proving (as Mr. Northway says) that it was there before.

The pieces of bark I sent Mr. Northway, with pads of rubber on them, were taken from trees which had never been tapped before, but were tapped on his system—some of them six days and others 12; and none of them had boils of any sort on their bark before the operations, in fact, we watched some of these boils with pads of rubber underneath them grow from day to day until the final stage was reached and the bark, cambium, and wood were in a rotten state caused by the putrefying of the drying latex shut up inside the bark.

The trees, as Mr. Northway says, were *not* scraped months before, but one to two weeks before Mr. Northway's system was tried, and in every tree where the bark was examined the prickers went in right to the wood, far too deep—not too shallow as Mr. Northway insinuates was the case—owing to the corky bark not being all rubbed off.

In conclusion, I must say that although Mr. Northway thinks that rows of pricks one-sixteenth-of-an-inch deep in the wood of the Hevea tree will do them little or no harm, Mr. Petch and others hold a different opinion; and it is the impossibility of working carefully with the blunt pricker—which requires a lot of force to start it and once started goes right to the wood—that is the grave danger.

It is rather ridiculous the way some people write and run down those who do not believe in Mr. Northway's system; for I can assure you, Sir, that there is not a single rubber planter in the country who would not rather use Mr. Northway's system on account of its simplicity, if only he could level up yield per acre, and level down cost of upkeep of the system and freedom from disease—to the old systems.

I ask you, Sir: is there any one, Superintendent or cooly, who can judge from the outside of the tree the exact thickness of the bark? And if not, how is it possible to put in the pricker just the right distance—so that all the latex is drawn out without injury to the wood? What happens in practice is that either the pricker goes in too far in a thin-barked tree, or else not deep enough in a thick-barked one; and so the latex cells are not all touched and the tree does not yield satisfactorily.

I am not against the sharp pricker. I think it a most excellent tool, but it must be used in conjunction with paring, or not at all.—Yours faithfully,

D. B. WILLIAMSON.

[We are exceedingly glad that Mr. D. B. Willamson has written this illuminating letter over his own name—as it was, we believe, on Sunnycroft Estate, that the rubber pads resulting from the new tapping system were first discovered, a phenomenon which was first made public in our columns. We are not so much concerned with the initial correction of Mr. Northway's examination of the pads of rubber on the specimens of bark sent down to Deviturai, although the most startling discovery made by that expert—that there were pads already existing before the pricker pierced the bark in some cases—is denied by the Kelani Valley planter. What is more important is the opinion, with which it is difficult to quarrel, that the use of the pricker is dangerous in so far as it is impossible for coolies to judge of the thickness of bark and to regulate the depth to which

they force the instrument accordingly. There is, therefore, a continual peril of reaching and penetrating the wood and setting up the accumulations of unreleased rubber which forces the bark away from the tree and sets up "bark rot," as a Kalutara Superintendent describes it elsewhere. Mr. Williamson emphasizes the fact, which the valiant defenders of the Northway system would do well to note, that all rubber planters would prefer the Deviturai methods, because of their simplicity, if they afforded an equal yield and freedom from disease with no higher cost of upkeep. Referring again to the following letter from Kalutara district, we see Mr. R. J. Booth's case of sub-cortical rubber pads, where tapping had been done with the knife, is explained by attributing it to decomposition of tho laticiferous cells due to Bark Rot, which in the early days of tapping often resulted from the use of a scraper instead of the more careful paring now practised. He differentiates the pads formed by the new system as being entirely due to the essential action of the pricker itself. Furthor, he points out that the quality of work done by the cooly under the new system is impossible to check: that it requires men of very good physique if it is to be applied to mature trees with, say, bark three-quarters of an inch thick. As matters at present stand, it seems that the use of the knife in tapping is still the best, though the ideal system both to work and check may have yet to be discovered.

III.

Eagles Land, Neboda, June 10th.

Dear Sir,—Mr R J Booth, in a previous letter, stated that the pad found in one of his trees was due to tapping in February when the troes were wintering and the remedy was cutting away the bark. In this case I should be inclined to think that the pad was formed by tho decomposition of the laticiferous cells due to "*Bark rot.*" But in the case of pads formed by the new system the *pricker must not be held responsible though its faults are well-known.*

In the early days when tapping—say, hacking the cambium—was considered a novelty, cleaning the stem by a scraper—similar to sweat scrapers—was one of the processes involved in that system. Some of the coolies did this work judiciously under my personal supervision and some, where I was not in touch with them, did it as *they liked.* Those trees that were badly scraped so as to irritate the cortical cells *in dry months* got weaker and *bark dried up in patches* with the result that they got "*Bark rot" with accumulations of dried latex*—or rubber pads, as they are termed now.

I am, therefore, inclined to think from the explanation given by Mr Northway that the *formation of rubber pads by using his system was due to scraping the stem.*

As regards the new system, I do not think it has any advantages over the *established paring* system. What *check* have you on the quality of work done by the cooly? He can dig into the wood with the pricker as deep as he can and yet will come forward as an A 1 tapper and get his 40 cents a day. It will take years to find out the mischief done by him and by that time he gets his tundu and walks off.

Surely, it requires giant's strength to force the blunt teeth of the pricker into matured bark $\frac{3}{4}$ in. thick. Paring is now done by boys, girls, women and shuck coolies; in fact, by all coolies who can neither prune nor handle a mamoty or an alavangoe, but mature trees under the new system require *men of very good physique.*

As regards yield, a set of 2 coolies by *paring on my system* bring in (10) *ten lb. of dry rubber* (5 lb. each) *a day from 125 mature trees 12 years old.* This is the *maximum* at present. Where the trees are scattered, mixed with 20 in trees, the *minimum* they bring is four lb. dry rubber (*2 lb. each*). It must be understood, when considering the yield, that the rubber trees on this estate are all planted through tea. A system that is easy to work and to check with good results will be a boon.—Yours faithfully,

T. L. SRINIVASAGAM.

A Well-known V. A.'s Opinion.

Mr J P Anderson, the Kelani Valley Visiting Agent, seen by a representative of the *Ceylon Observer* and asked what effect he thought tho new tapping system would have on rubber trees said he could not yet say as they wore still experimenting with it. He did not quite like it up to date, but he had not given up all hope of it because ho had not givenit a long enough trial. He wanted several monthsto try it.

LESS HARM WITH A PRICKER.

Asked whether he thought it could be regulated equally as well as the ordinary knife tapping systems, Mr Anderson said he certainly did. Less harm was done with a pricker than with a knife. It was known exactly where the latex lay, next to the cambium, and to get at it they had to cut as near the cambium as possible and there was a very great danger in cutting to that depth. What he liked about the pricker was that they could, with the knife, make a shallow incision and then get the latex out with the pricker. He was of opinion that out of an equal number of trees far more had been damaged with the knife than with the pricker.

THE HALF-SPIRAL SYSTEM.

In answer to a query as to what methods of tapping he had found most satisfactory so far Mr Anderson said that up to date he liked the half spiral.

Mr. Williamson's Letter.

Mr. Williamson's letter, which appears on the previous pages, was then shown to Mr. Anderson who, after reading it, said it was quite right, he quite approved of it.

Mr T Petch, Government Mycologist, to our contemporary recently said that black patches and the rubber pads depend on whether the pricker goes through the cambium into the wood. If you can prick without touching the cambium, you will not get either of these symptoms. It is impossible for the rubber pad to

form until the bark separates from the wood. The cambium is killed; that causes the black patch and separates the bark from the wood. The black patch is the death of the cambium round the pricker-hole. There would be a black mark with the old pricker, but there is a bigger one in this case because the old pricker was sharp, and this one is blunt. Mr Northway certainly has pricked without touching the cambium, but Mr Northway's bark—at least that which I measured—is about six to eight millimetres thick. Other people are working on thinner bark. A lot of rubber trees have a much thinner bark than that at the age of from four to seven years. If they prick this thinner bark, they are absolutely bound to go into the wood. These questions of rubber pads, and whether you can prick without touching the cambium, miss the main objection to the pricker, and that is that the bark which is formed under the pricker cuts is *not laticiferous*. That is Dr. Fitting's discovery, and I found it fully borne out in samples of Mr. Northway's bark. The use of the renewed bark would be delayed, say, eight or ten months, as compared with the renewed bark with the knife. I do not suppose that the effect of the pricker would never work out, but it certainly would take more than six months. This is the main objection. The black patches and rubber pads may be a little alarming, but the ultimate effect of the black patches will be absolutely *nil*. It is against the system inasmuch as you cannot go on pricking as long as you ought to. The tree will recover. The results complained of by planters are the effect of following the Northway system too well. Their bark is probably thin, and they have put the pricker right through.

LORANTHUS IN NUWARA ELIYA DISTRICT.

New Galway, June 5th.

DEAR SIR,—The discussion *re Loranthus* at the recent meeting of the Nuwara Eliya District Planters' Association though—in a way—interesting is scarcely instructive, as it makes it appear that this undoubted pest is of recent origin, or introduction. I do not know how many years back the speakers alluded to, but I can remember over 40 years ago the dilapidated appearance of the Acacia Melanoxylon trees then growing round "Barnes' Hall," (now the Grand Hotel), and how they were gradually killed out by this parasite. The spaces now occupied by the market and K. A. Saibo's shop were then covered with dense growths of Rhododendron trees, many of them carrying finer specimens of *Loranthus* than are generally seen now; and the surrounding jungles were full of it, so it is rather misleading to say that "it has begun to enter our jungles."

As to a scientific report on *Loranthus*, not many years ago—under 10, probably—a member of the then Scientific staff of the Botanic Gardens made a study of the subject and I think read a paper on it. His great concern was to discover how it was propagated, *i.e.*, did the birds swallow the fruit, and so spread them, or did they merely carry them to the most convenient perch, swallow the pulp, and allow the seeds to remain to grow in time into other plants? Several birds were sacrificed to his thirst for knowledge. Some time back the preservation of bird life was much advocated with a view to keeping down insect pests. Does this account for the "alarming spread of *Loranthus* to the tea fields?" If so, shall we now be called upon to shoot all birds at sight? How is it proposed to work the Pest Ordinance in this connection? The source, from which it has spread, is undoubtedly the Government jungle. Will Government ignore its responsibility, and only require private owners to eradicate the pest?—or will there be a general crusade? If so, "what will it cost, and what will it pay?" and "is the game worth the candle?" Like everything else, it takes time to develop, and as the tea bushes are so frequently pruned there should be very little difficulty in keeping them free of the parasite. The case cited of a large area having to be collar-pruned on account of it must be quite exceptional!

I have seen *Loranthus* on coffee, tea, cinchona, camphor, gums, grevillea, and dozens of other trees. The question is not—where will it grow, but the reverse: during the fruiting season it is not uncommon to see the germinated seeds hanging from the telegraph wire where it passes by *Loranthus* infested trees.—Yours faithfully,

A. J. KELLOW.

DRIED PLANTAINS FROM CEYLON.

I.

Croydon, May 20th.

SIR,—It seems to have been forgotten that in the '60s the Rev. Mr. Thurstan used to prepare dried plantains for export. They were packed in soldered tins to preserve them from damp. When I was a boy at school in England, an occasional present of a tin of these dried plantains was most welcome. As regards reviving this industry, I fear that Ceylon cannot compete with Jamaica, which is able to send its Mafuta dried bananas to England in wooden boxes or even cartons.

DONALD FERGUSON.

II.

June 11th.

DEAR SIR,—The information given by Mr. Donald Ferguson in your last issue is most interesting.

There is a great difference between "dried plantains" and the Mafuta brand bananas. I knew of people who sun-dry plantains, but the product is very different from the article on the English market, which brings out the fig flavour that is absent in ordinary sun-dried fruit. One thing is certain, viz., that it is not every variety of the fruit that is suitable for drying. Mr. J. D. Vanderstraaten, who has been lately experimenting in the desiccation of ripe plantains, has proved this fact conclusively. Our finer "table plantains" will not do, but coarse mawkish fruit common in upcountry bazaars seem to be the most suitable. There is also possibly something in the "curing," even if it be only of the simple kind which makes all the difference between new cheese and "ripe" cheese. It would be worth knowing how Mafuta bananas are prepared.—Yours truly,

C. D.

EXPERIMENTS IN TAPPING CEARA RUBBER.

IN NYASALAND.

(*From the Handbook of Nyasland.*)

(The African Lakes Corporation, Limited, Chitakali Estate.)

These experiments were commenced in November, 1906, and are still being continued. Of several systems tried the "full herring bone" has been adopted as the best for trees measuring between 25″ and 35″ in circumference 3 feet from the ground.

BOWMAN-NORTHWAY NO. 2

Patent Tapping Knife was selected as the most suitable for trees of this description, both for opening the grooves and paring off the lower edge of the grooves in subsequent tappings. A much simpler knife is, however, being prepared and will shortly be tried. After stripping off the outer covering of thin bark the trees are left for a week or 10 days before tapping. This allows the tissues to recover from the exposure to the atmosphere, and another thin crust will have formed over the surface. By removing the shield and leaning the knife a little to one side a vertical groove is cut, 6 or 7 feet long, running down to within a few inches of the ground level. Great care is necessary, both in cutting the original grooves and in subsequently paring the lower edge of the grooves, not to cut through the cambium and expose the wood. The cambium, unlike the cortex, does not recover after being incised but produces a knot in the wood, and if badly incised the tree will be killed.

After making the vertical groove, a small tin spout is inserted at the lower end, under which a vessel is placed to receive the latex. A right-angled triangular piece of tin, the right angle measuring 2′ and the sides 17″ × 17″ approximately, is used as a guide for cutting the oblique grooves which should be at an angle of 45° and 1 foot apart, all leading into the vertical groove. On trees from 18″ to 20″ in circumference the "half-herring-bone" system is sufficient. On trees branching out near the ground or measuring over 35 in. in circumference it is advisable to have two vertical grooves on opposite sides of the tree, and the half or full herring-bone system followed. It is advisable to leave a space of 2 or 3 inches between the extreme ends of the oblique grooves running from opposite sides of the tree.

At first it was found that the latex dried very quickly in the grooves, and that only a small portion found its way into the receptacle at the base of the vertical groove. With the assistance of drip-tins this difficulty has been largely overcome. A few drops of liquid ammonia are added to the water in the drip tins to prevent the latex coagulating too quickly. Two smart lads are occupied in collecting the latex and arranging the drip-tins for each tapper.

THE DRIP-TINS ARE NOT FIXED

to the trees, but are held by the boy and shifted from groove to groove as the latex ceases to flow. After the latex has ceased to flow in all the grooves it is strained through a fine wire mesh and poured into the coagulating bowls. These should be of uniform size and fairly flat, as a thin biscuit is preferred. The latex commences to coagulate in a very short time after leaving the tree, especially if it is in small quantities, and is mixed with a considerable quantity of water, which is the case when using the drip-tins. There should be no delay, therefore, in pouring the latex into the coagulating bowls. By 4 p.m. on the same day on which it is tapped the latex has generally all coagulated. It is then rolled on a table, or slanting board, with a hand roller, and constantly washed in clear water. The wet biscuits are then placed on a wire frame, and left to dry in a well-ventilated shed, from which the sunlight is practically excluded. If the biscuits are sufficiently thin they should all be dry and ready for packing in the course of three weeks or a month.

The table of statistics will show the results obtained from one batch of trees after following the foregoing system. The trees were tapped about every other day for one month, making 12 or 13 tappings for the month, then allowed to rest a month, and tapped again the following month, and so on until the trees had undergone either a complete cortical stripping, or only half, as desired. It is estimated that one-tenth or one-twelfth-of-an-inch is all that should be removed of the cortex in one tapping after the grooves have once been opened. If this rule is followed, it will take two years to entirely strip a tree, after which time operations could probably be continued on the new bark. After nearly two years' experiments the trees are showing

NO ILL EFFECTS THROUGH EXCESSIVE TAPPING

except where the cambium has been inadvertently incised.

It may be added that the Ceara trees on this estate are of various ages, and had received practically no attention before these tapping experiments were commenced. Many of them had been damaged by bush fires, etc.

The weight of dry rubber is approximately one-half the weight of wet rubber.

Ceara rubber biscuits produced as above, and sent home from here, were

VALUED AT 4s 10D PER LB.,

since which time, however, the market for all classes of rubber has fallen considerably.

Regarding the *cost* of collecting Ceara rubber in the manner above described the following statistics may be of interest, being compiled from the latest 5 months' results (to September 1908) on this estate. One native tapper, with an assistant, taps 50 trees per day, the average quantity of wet rubber obtained daily, taking the average for 86 working days, being 9·24 ounces, yielding 4·62 ounces of dry rubber. The cost of collecting and preparing the rubber works out at 1s 2½d per lb., excluding cost of European supervision.

It is anticipated that with the most suitable type of knives it will be possible to tap the trees every alternate day throughout the year, viz., 156 working days ; and—taking the past 86

working days as a basis for calculations,—100 trees tapped every alternate day for 86 days give a daily average of 18·49 oz. wet rubber. Therefore 100 trees tapped every alternate day for 1 year of 165 days give in the year 2,884·44 oz. wet rubber. 2,884·44 oz. of wet rubber for 100 trees=28·84 for one tree. Therefore if the land is planted up with 1,000 trees to the acre (6½ × 6½) which is about the most suitable number, this means that 1 acre of land should when the trees average the same girth as those now being tapped, yield 1,803 lb. wet rubber or say 901½ lb. dry rubber, value at 2s 6d per lb. = £112 13s 9d.

It would probably take the trees about 6 years to attain an average size equal to those now being tapped, though they would be yielding a certain amount of rubber from the time they were 3 years old if properly cultivated and cared for.

STATISTICS OF 18 CEARA RUBBER TREES TAPPED 62 TIMES.

Dating from 21st November, 1906, to 6th September, 1907.

Date when tapped.	No. of times tapped.	Total daily yield Wet Rubber.	Date when tapped.	No. of times tapped.	Total daily yield Wet Rubber.	Date when tapped.	No. of times tapped,	Total daily yield Wet Rubber.	Date when tapped.	No of times tapped.	Total daily yield Wet Rubber	Date when tapped.	No. of times tapped.	Total daily yield. Wet Rubber.
		Oz.			Oz.			Oz.			Oz.			Oz.
21 Nov.	1	5¾	30 Jan.	13	2	3 Apl.	26	3⅛	11 June.	40	7¾	9 Aug.	50	6
26 ,,	2	6¼	1 Feb.	14	2⅝	5 ,,	27	3⅝	13 ,,	41	6	12 ,,	51	7½
28 ,,	3	6¼	4 ,,	15	2¼	8 ,,	28	5¼	15 ,,	42	4¾	14 ,,	52	5¼
30 ,,	4	6¼	6 ,,	16	2⅛	10 ,,	29	5	18 ,,	43	7¼	16 ,,	53	3¼
3 Dec.	5	6½	8 ,,	17	3⅜	12 ,,	30	5½	20 ,,	44	6	19 ,,	54	2¾
6 ,,	6	3½	11 ,,	18	3⅛	15 ,,	31	7⅜	22 ,,	45	5¼	21 ,,	55	3
10 ,,	7	3¾	13 ,,	19	3¾	17 ,,	32	5¾	25 ,,	46	5¾	23 ,,	56	2
12 ,,	8	3⅛	15 ,,	20	3	19 ,,	33	5½	27 ,,	47	5	26 ,,	57	1¾
14 ,,	9	3¼	18 ,,	21	3¼	22 ,,	34	6¾	29 ,,	48	3½	28 ,,	58	2½
17 ,,	10	3½	20 ,,	22	3½	24 ,,	35	6½	4 July.	49	4	30 ,,	59	2¾
20 ,,	11	3⅞	22 ,,	23	4	26 ,,	36	6½				1 Sept.	60	3¼
22 ,,	12	4¼	25 ,,	24	4	29 ,,	37	7¼				4 ,,	61	2½
			28 ,,	25	3¾	1 May	38	7				6 ,,	62	2
						3 ,,	39	8¼						
		56¼			40¾			83⅜			55¼			44½ Total 280 Oz.

RUBBER-PLANTERS' METHODS IN THE MALAY STATES.

MR. BOWLE EVANS' VIEWS.

An important interview with the latest Ceylon planting visitor to the Malay States, who has kept his eyes and ears open and visited no less than 17 properties, appears in this issue and doubtless will be carefully read by many investors in, as well as growers of, the elastic product. Mr Bowle-Evans first of all gives a nasty knock to rupee scrip, but we do not think it will make this class of share any less popular; and if there is uncertainty about labour, it will affect sterling companies just as much as the dollar or rupee ones! Of course we admit that the home country provides a much larger number of investors, and so far Mr Bowle-Evans makes his point. He compliments planters further east on their excellent work under much more difficult circumstances generally than in Ceylon; on this account the schooling here has been an excellent preparation for the all round work required in Malaya. On the Northway tapping system the point emphasized in condemnation is the quantity of additional transport required; and this, of course, is against it on rough or hilly country. The view that Sumatra's indenture system is better than free cooly labour is a novel one for a Ceylon man; but, other things being equal and free cooly labour having caused increasing trouble in the past, it is not surprising that a more dependable force becomes praised at this date. The remarks on the cessation of Tamil emigration will be noticed, especially as the idea of a Government-fixed limit to coast advances is mooted. Mr Bowle-Evans speaks with much common sense on the nervousness prevalent with regard to increasing the cost of rubber per lb. when necessity demands—at the same time as strenuous efforts are being made to reduce it all round. This, however, depends on directors and proprietors; no doubt there will be more leniency when the crop is big, even if cost of production has risen slightly. We cannot comment in detail on the highly important paragraphs with reference to disease in the Malay States; but while every other prospect is glowing, these sections of this valuable contribution to present-day knowledge should be read and re-read and applied individually. Though optimistic as to prices Mr Bowle Evans has his fears of the facilities for the spread of disease; and we call special attention to his concluding remarks.

INTERVIEW WITH MR. H. ST. C. BOWLE-EVANS.

Mr. H. St. C. Bowle-Evans, who returned from the Straist on the 17th June, was kind enough to grant an interview to our representative.

Valuable Information.

In answer to a preliminary enquiry Mr. Bowle-Evans said:—I have been away a month and have seen an immense amount in that time and gained information that is of the greatest value. I have received the greatest kindness from everyone.

I suppose you went on business?—Yes, business and pleasure combined. As a matter of fact I have a fairly large book in rubber in Sumatra and the Straits.

Ceylon Shares.

I suppose you are also highly interested in Ceylon shares?—Oh! dear no. Not anything like the same interests.

Have you any particular objections to giving your reasons?—Well, in the first place rupee scrip is not nearly so easily handled as sterling scrip. I mean that there is a very much larger market for sterling shares, and the investing public at home do not want to be bothered about "rupees" and also do not seem to know how to set about the purchase or sale of these shares. Again, transactions in rupee shares are, of course, more or less confined to those living in or closely connected with Ceylon; and, if the market weakens, or money is scarce, transactions are restricted to a comparatively few individuals. Lastly there is some uncertainty about labour; possibly not at the moment, but as to the future and when an appreciable quantity of the large planted acreage comes into bearing. This, I think, has frightened many "would-be" investors in rupee stock, quite apart from the fact that the rubber in the Straits and Sumatra is of quicker growth and in many instances the soil is richer and the climate more equable for rubber than in some parts of Ceylon.

Impressions of the Trip.

Would you mind giving your impressions of your trip?—No, I don't mind in the least, but I particularly wish it to be understood that what I say are my own impressions, knowledge gained by coming in contact with many Managers, visiting some 17 estates, by observation and the cheerful way in which everyone I met answered my numberless questions and gave me their ideas from practical experience.

How do you think the management of the general run of estates compares with Ceylon? Do you think Mr Val Carey's letter that appeared some time ago was a just criticism on the Superintendents?—In reply to the former question, I must say things are totally different if a comparison is to be made with tea estates. As compared with our rubber estates I think the management every bit as efficient; I would go further than that in saying that the way the huge acreages have been opened up in the Straits often under adverse circumstances reflects the greatest credit on all concerned. The work, too, is much harder than in Ceylon as we have a large trained staff of Conductors to assist and Surveyors to cut out blocks of the required size after a survey has been made, whereas in the Straits it appears that the planter has to do all this work himself.

As regards Mr. Val Carey's criticisms, the F.M.S. planters are still very sore about it—the general feeling being that he included in his criticisms all and sundry, whereas the rowdiness and drinking, which appeared to have inspired this letter, was confined to a few well-known Superintendents who have the sympathy of no one, and who did not play the game. One might just as well say that most of the Ceylon men were "rotters" because of the indiscretion of a few individuals.

I can only say that all the Managers and Assistants I met were excellent, keen, and intelligent workers and will compare more than favourably with any other part of the East.

The Northway System.

What about tapping and the Northway System?

Some of the oldest rubber shewed signs of bad tapping in the past—the result in some cases, I am afraid, of ignorance and carelessness combined. The tapping now carried out is excellent, in some cases too carefully done, if anything a fault, however, on the right side. As regards the Northway System, some estates are experimenting; but I fear no one had a very good word for it. Of course, there is the one objection, *e.g.*, that on Bukit land, it will be impossible to carry about the quantity of water required; besides there is the additional bulk in transport. There is a feeling too that Ceylon men are too fond of getting the leading V.A.'s to append their names to experiments—the practical worth of which, over a reasonable period, has not been by any manner of means conclusively proved, Mr R W Harrison's recent letter of a parallel in the Alleyn plucking system being very much to the point and also sounding a note of warning. It must be remembered that the F.M.S. planters are very conservative and are not inclined to adopt a new system of tapping or new tapping tools until the system or tools have been found thoroughly efficient. Hence instead of finding many and various tapping knives, there were only two or three places that I found using the pull and push knife; the tools usually and generally adopted being the ordinary gouge and the large and smaller farrier's knife. I cannot say that I agree entirely with the views of a large number of F.M.S. men that Ceylon planters are too much given to patenting knives, as after all the thoughts of the Ceylon men are directed towards an implement that is cheap in the long run, easily handled by coolies that are not experts, and one that will do the least damage in inexperienced hands. Again I venture to think that the different machines, now universally used, were originally the outcome of ideas and the inventive genius of Ceylon Planters and Engineers,

Labour.

What about labour?—Ah, Here it behoves me to be very careful. My own feeling is that Sumatra with its 3-year indenture system has one of the best labour forces going. The cost of each cooly is approximately £4. 4s. 0d. but I believe that the Javanese, at any rate on the estates I visited, are freely re-indenturing themselves for a further three years. Now think for a moment what this means as compared with un-indentured labour or compared, say, with ordinary labour or Sinhalese village labour. The important thing to my mind is that with indentured labour the Manager always knows the available labour force for tapping, whereas with the ordinary labour forces or a village community, you never know how many tappers may be available. You may get too many or too few, or none at all at times, and it is an indisputable fact that regular and frequent tapping gives the best yields. Tapping at indefinite periods can never give the best results. As regards the F. M. S., I do not think the labour question need alarm anyone, in spite of the huge acreages opened up. Any number of Javanese could be imported, and local Chinese are available and are excellent tappers although they are rather expensive, *e.g.*, 45 to 55 dollar cents against an all-round average of about 27 cents for Tamil labour.

Tamil Labour.

There is some anxiety expressed as to the rather sudden cessation of an influx of Tamil labour—a serious matter when it is understood that Tamil labour is the cheapest and most economical. I hardly feel justified in expressing any opinion as to the cause, owing to my short duration in the F. M. S., but it is alleged by many that the elimination of Sunday names by the majority is to some measure responsible. This, however, I would not consider the cause of the great falling-off in arrivals. I should be inclined to think that it is partly due to the system of recruiting now in vogue, the law being that no debts contracted between employer and employee, prior to arrival, can be recovered. It is possible that a system of Government allowing a fixed and limited sum to be advanced to the cooly before arrival, over and above the amount necessary to bring him free to the country may have to be adopted; but this will open up a big question and would probably lead to register legalised discharge notes, bolting, and many other attendant evils with which we in Ceylon are only too well conversant and which under the present system in the F.M.S. are unknown. On every hand one hears of the strennous

EFFORTS BEING MADE TO REDUCE THE COST OF RUBBER PER LB.

f.o.b., also comparisons being made as to cost of tapping; but there is one point that seems to have been lost sight of by Directors and others alike—and that is, it is nonsense tying Superintendents down to any particular cost for tapping, as I feel that the maxim of rubber estates should be tap—tap—tap!—and if a sufficient Tamil labour force is not available, recruit for all you are worth; but in the meantime take on Chinese, even at a much increased cost, and get quantity. What amazed me was that some estates rest their trees and tap at indifferent periods rather than increase their cost of tapping per lb. of rubber by taking on other labour. It may be found necessary at times to rest the original tapping area, but why not tap above this even if more expensive and if the latex is rather less in quantity? Surely rubber at anything over 2s per lb. would amply repay the small initial cost involved, let alone rubber at 6s? The sooner Directors and others recognise this, the better for all concerned, although everyone is in accord with the Directors that strict economy even at 6s per lb is *absolutely essential* even on estates making big profits. Generally speaking, most of the estates appear to have sufficient labour. One well-known dividend paying Company could, however, I feel sure, make a considerably bigger profit with more labour.

Disease.

What about disease?—As you know, alarmist reports have frequently been circulated in Ceylon and elsewhere about white ants, but little has been heard about other diseases.

The White Ant Pest.

The white ant pest (Termes Gestroi) is different from the Ceylon white ant and need give no cause for anxiety, as Managers are taking all sorts of precautions. The ant exterminator with sulphur and arsenic, although only lately taken up, is likely to solve the difficulty, but failing it doing what is claimed, the more expensive but effective method of clearing the land of all dead timber by burning it, will practically eradicate this pest.

Fungus.

The root fungus (fomes semitostus) is very prevalent on all clearings, and attacks rubber from 2 to 5 years old and may be compared to the Rossillinia radicerperda so common in Ceylon. Great attention is being paid to this fungus disease and many Managers are eradicating the disease by burning all dead wood and cutting out stumps, a very expensive addition to the initial cost of bringing rubber into bearing, but effective in both eradicating white ants and fomes semitostus. There is a difference of opinion as to whether such an expensive method is or is not justifiable, or whether careful watching and checking of the above is not only more practicable, but economical. Whatever the opinion expressed there is one thing to be said, that when once thoroughly cleared of dead timber the werk is finished once and for all, and the future cost of checking disease will be practically nil. The cost seems to be anything from $20 to $45 per acre after the first two years, much of the timber having by then rotted.

Branch Disease.

The most important disease to my mind is the branch disease, which I had an opportunity of examining on one estate. The branches appear to darken, with the underlying cambium of a dark bruised colour. These branches die back until they meet a fork, when they continue an upward or downward course which quickly kills the tree. The whole point seems to be as to whether this disease is internal or external.

If the former, and always provided all known infected areas are carefully watched, and the branches topped off and burned, no serious damage should ensue. If the latter, the spores will be carried from estate to estate and the whole area rapidly affected. Having had no opportunity of meeting Mr Gallaghor, the Government Mycologist, I am unablo to ascertain for certain as to the possible danger of this disease becoming universal. From those whom I discussed the question with, very little information could be obtained. It appears that in most instances this branch disease has been confounded with the "fomes semitostus." There is no doubt, however, that unless taken in time, this disease rapidly spreads. I understand that tho disoaso is not uncommon in Ceylon.

LALANG, PASSION FLOWER, ETC.

What about Lalang, Passion Flower, &c.?

I was agreeably surprised to find that practically all the places I visited were free of weeds, especially lalang, the curse of Rubber estates. That lalang can be easily and effectively dealt with, I have no hesitation in saying; but the initial cost of eradicating it is heavy, but when once done, with proper care and supervision it should never give any further trouble. Many thousands of pounds have been wasted over a want of organisation or rather a want of grasp of the situation. It is whispered that Ceylon men, without much knowledge of this pest, men who have not been long in the F.M.S., have been the worst sinners; this is as it may be. Holing 18" all over—and shortly afterwards, taking out all "points" and roots and continuing at frequent intervals—is the only effective method and will in a few months overcome any lalang, but everything depends on labour and frequent weeding at the commencement. Let a little lalang get a footing in a clean estate even, and it spreads with incredible rapidity. Much passion flower is growing over large areas; crotalaria also finds favour on somo estates. Both these should be avoided if possible; or at any rate crotalaria, if planted, should not be allowed to grow to the extraordinary height to be seen on some estates. It stands to reason that overgrown crotalaria is so dense that no one can move about the fields; hence considerablo damage is done by 'fomes semitostus and possibly white ants, before it is discovered. Crotalaria is not a weed-destroyer although it keeps down weeds when it entirely covers the ground. Passion flower on the other hand does effectively kill out lalang and other growths, but is generally a sign of want of sufficient labour. It occurred to me that much expense could be saved by sowing passion flower directly the clearing is burnt off and sufficiently cool—not waiting, as is generally done, until lalang appears. This would enable the work of planting up to be carried on without great anxiety about weeds.

A COMPARISON.

How do you compare Ceylon with the F M S and Sumatra, and what are your general impressions of the future of rubber prospects?

The general feeling is that Ceylon is behind both places in quickness of growth, with the possible exception of some parts of Kalutara, My own idea is that for the first two years or so there is not a vast difference as compared with the most favoured Ceylon districts, but after three to four years the growth in Malaya is far ahead. In the F.M.S. there are many blocks of four years old rubber with a large percentage of well-grown, tappable trees—many being 30" and upwards in girth.

RUBBER PROSPECTS.

As to the future, I think that there is an immense fortune to be made out of rubber, almost at any price; and there is no knowing which quantity per acre can be obtained when the rubber is a bit older. I don't fear labour, root disease, or white ants, but am apt to be a little pessimistic; with the huge areas opened up, there is always a possibility of nature stepping in and disseminating some virulent disease by the aid of spores—more especially as little sunlight can get through well-grown rubber, if at all closely planted and this alone would tend to foster and encourage fungoid disease.

MANURING IN CEYLON.

USEFUL INFORMATION.

"PROFITABLE MANURING IN CEYLON" is the title of a handy, exceedingly useful, and attractively got up little booklet issued by the Colombo Commercial Company. After a short sketch of the development of agricultural science as applied to manuring, mention is made of the three substances, Nitrogen, Phosphoric Acid and Potash, which the plant finds a scarcity of in the soil. Lime, it is mentioned, is more for the purpose of improving the mechanical or physical condition of the soil than for use as a plant food. All soils contain large supplies of these plant foods in solid form but a plant does not absorb solid matter, and, therefore, the foods must be brought into solution which is brought about partly by moisture in the soil, but to a greater extent by the juices, or sap, secreted by the roots. These secretions are faintly acid and only materials which are readily attacked by this weak acid solution are available as plant foods, the fertility of the soil depending on the proportion of the plant food it contains which is soluble in this weak acid. This proportion is limited and as crops are grown year after year the supply diminishes. The object of agricultural science, therefore, is to increase the stock of available plant food in the soil, and this increase is brought about by tillage and manuring. In Ceylon, farmyard manure is scarce and the planter has to rely on artificial manure. Analysis, however, proves these "artificial" manures to be perfectly "natural" ones, when their origin is considered.

The whole question is then dealt with under three headings: "Manuring for Nitrogen," "Manuring for Phosphoric Acid," and "Manuring for Potash." In each the particular uses of the substance are exhaustively explained and the best form in which they can be applied to the soil discussed.

In the section devoted to nitrogen it is stated that groen manuring is the practical application of the theory that loguminous plants have

the power of assimilating Nitrogen direct from the air by means of their root nodules, which are colonies of nitrifying bacteria, which convert atmospheric nitrogen into forms in which it can be assimilated by the plant and enable it to store up large quantities of nitrogen in this way. If, then, a leguminous crop is grown and returned to the soil after maturity the amount of nitrogen is largely increased, and the supply of the nitrifying organisms which are so essential to fertility is maintained. It is further stated that the theory is one which deserves consideration by all planters.

"Not only is the amount of Nitrogen in the soil increased by green manuring, but the amount of decaying organic matter and humus also; and consequently the texture, retentivity, and condition of the soil generally, is improved. The soils of Ceylon are, for the most part, deficient in humus, so that organic manures are especially necessary. Green manuring is one of the best ways of applying such, and is one which we venture to predict will come more and more into favour with Planters as its beneficial effects are realised. Of course the main object of green manuring is to increase the amount of Organic matter and Organic Nitrogen, and it cannot take the Place of Artificial Manuring for Potash and Phosphoric Acid or as a source of quickly acting Nitrogen. It however brings the soil into the condition in which it is best able to take advantage of artificial manures, and forms a good basis for the economical use of such fertilisers."

Phosphoric acid is said to rank next to Potash as a necessary constituent of healthy wood and muriate of potash is mentioned as a good fertiliser for

COCONUT TREES.

The general conclusions drawn are as follows: "The manurial requirements of the Tea plant are, in order of importance, Nitrogen, Potash, and Phosphoric Acid. Shortage of the last two is not followed by any immediate diminution in yield, although continued lack of them produces poor, scrappy bushes liable to attacks by pests and blights. Shortage of Nitrogen is always, and very soon, followed by diminution in yield and in the general vigour of the bush. What should be aimed at is to keep an ample supply of these plant foods in an available form for the plants' nutrition, and so to build up their structure as to produce strong healthy bushes with plenty of reserve energy to resist the attacks of pests and the advent of the unfavourable seasons. Bearing these general considerations in mind what course should the planter take to ensure his system of manuring being profitable? Having decided in what way his soil needs fortifying, his own judgment should indicate to him what manures to choose from the list of those which supply the ingredients he needs. He has two things to consider, first, the need of his crop for immediate nutriment, as against slowly acting manures; and second, the cost per unit of the various constituents of the manures at his disposal, (found by dividing the price per ton by the percentage). Thus he will find that at the present time Sulphate of Ammonia is cheaper per unit of Nitrogen than Nitrate of Soda, although, as regards availability, the order is reversed and Nitrate of Soda takes first place. Again, Kainit, which appears at first sight to be a cheap manure, is really dearer per unit of potash than either Sulphate of Potash or Muriate of Potash. What he has to decide is how to get the best value for his money, value being not only a matter of quantity, but also of quality, as determined by the suitability of the manure for the needs of his crop. A chemical analysis of the soil is in some cases necessary before one can judge what plant foods are lacking, and in the early days of artificial manuring, in Ceylon, this was even more necessary than it is now. The Planter has been early alive to the fact, with the result that a large number of useful soil analyses have been made, and the average composition of the soil in the various tea districts is now well known. Still, soil analysis should not be neglected altogether, for such analysis may furnish useful information concerning the condition of availability of the fertilising elements. A strict watch should be kept for signs of falling off in either quantity or quality of the tea crop, and steps taken to correct it. Mixtures which are suitable for bringing an estate up to the mark as regards yield are not always the best for maintaining or improving the quality, where the bushes are already strong and healthy and the yield sufficient. While the Chemist can, by analysis, tell the apparent needs of the soil, yet he alone cannot satisfactorily settle the question of estate manuring. It is to the Planter—the man on the spot—that he must look for help and co-operation. Information regarding quality and yield of tea, health of the tea bushes, local conditions of climate and rainfall, and personal observations regarding best methods of working can only come from the planter, and it is by such co-operation that the latter can ensure the best results for himself, and make it certain that his manuring is not only profitable but that it is maintained at its highest efficiency.'

Finally, an account is given of the manure trade in Ceylon, with special reference to the Colombo Commercial Co.'s participation therein, and at the end of the pamplet an excellent series of definitions of the various manures in use in Ceylon is given.

1,910 RUBBER CROPS: FORWARD SALES.

GRAND CENTRAL.—No. 1 Crepe, quantity not exceeding 112,000 lb., at R3·70 per pound. No. 2. Crepe, quantity not exceeding 20,000 lb., at R3·60 per pound.

PALLEGODA.—No. 1, quality only, on an estimate of about 40,000 lb.—for R3·70 per lb.

RIBU RUBBER CO., LTD.—Pending report of 1910 crop estimates, (1) No. 1 Pale Crêpe up to 30,000 lb, at R3·70 per lb. and (2) No. 2 Crêpe up to 5,000 lb. at R3·60 per lb. Crop figures are subject to amendment by 31st Dec., 1909.

KALUTARA COMPANY, LTD.—No. 1 quality rubber (Best Biscuit, Pale Crêpe or Sheet) of 1910 crop at R3·70 per lb. It is estimated that about 40,000 lb. will be delivered under this contract.

SEREMBAN RUBBER CO.—best Crêpe A rubber of 1910 crop from the Company's estate at R3·70 per lb. It is estimated that about 180,000 lb. will be delivered under this contract,

RUBBER PLANTING IN PAPUA.

"I have come back with the opinion that Australia has got a good thing in Papua," said the Minister for External Affairs, Mr. Batchelor, who arrived in Sydney yesterday from a visit to that territory. The Administrator, Judge Murray, accompanied him in the steamer "Merrie England" to the different spots on the coast; Mr. Staniforth Smith, the Director of Mines and Agriculture, took him up in the hills. There was nothing in the way of a "big feller white man" in the Minister's appearance among the dusky denizens of Papua. So many difficulties occur in the way of getting interpreters that he was not formally introduced. The variety of languages, he said, is almost as great as among the peoples of Europe. He visited the big rubber plantation belonging to the syndicate with which Sir Rupert Clarke is connected. Here there were 600 acres under rubber, and the manager,

MR. WESTLAND, OF CEYLON,

proposes to plant another 200. This plantation has now trees on it, some of which are two years old. Five years from commencement have to elapse before they can be tapped. No rubber is at present exported except the native variety, which is of considerably less value than the para rubber. A planter at Sogeri, Mr. Ballantyne, has some trees which will be ready next year, so that the trade will probably then make a start.

Back again at Port Moresby Mr. Batchelor shaped his course for Dedeli, inspected a

COCONUT PLANTATION

there, and then went to Rigo, where he saw a plantation of

SISAL HEMP

and three machines installed for treating it. The London Missionary Society has a fine station at the place. It is also the locality of a Government nursery. On an island of Cloudy Bay is another mission station. The Minister called at it, and was entertained by the Rev. Mr. Sackville. Thence he passed on to Samarai, Milne Bay, and Woodlark Island, and also to one of the most interesting parts of Papua from a scenic point of view—Cape Nelson, with its magnificent fiords, said to surpass those of Norway.

"The soil in New Guinea," said Mr Batchelor, "is, as far as I saw it,

WONDERFULLY FERTILE.

The climate is strangely variable. In the dry belts the rainfall averages about 30 inches a year. In the others it's about 180. Those planters who have experience in rubber say that in no place in the world does the tree make such early progress. I met the miners on the goldfields. Those at Woodlark were very hopeful. They told me that a fresh impetus had been given to things by an amalgamation of Companies, and by the good results that have been met in the mines at depth. They are down as deep as 500 ft. At Sogeri I saw the copper mines. They are waiting there for operations to be started by a new Company."

Mr Batchelor was surprised to find many different opinions about the value of the native labour in Papua. "It appeared," he remarked, "to be according to the country the men were drawn from. Some of the Papuans are good workmen. They told me at Woodlark Island that they considered the labour the best in the world."

"The best native labour?" was suggested.

"No," replied Mr Batchelor, "the best in the world. They are working ground on the goldfields that wouldn't pay here." In other parts, among both miners and planters, he found the opposite opinion.

There was considerable dissension in the Government service in Papua about a year or more ago. The Minister reports that no friction whatever exists now, and he was exceedingly pleased at the work done by the officers.—*Sydney Herad*, May 19.

INTRODUCTION OF GOURAMI INTO CEYLON.

The gourami (*Osphromenus olfax*) is a fresh-water fish belonging to Java, which has been introduced into Europe as an aquarium fish, and into Mauritius, Cayenne, and India as a food-fish. It is recorded as attaining a length of two feet and a weight of 20 lb.; but it seems doubtful whether 20 lb. of muscle can be concentrated into a length of two feet. However that may be, it has long been known to possess an "exquisite flavour"; and has quite recently been characterised in the Cambridge Natural History as "one of the best flavoured fishes of the Far East." Under these circumstances I had no hesitation in recommending Government to communicate with the Government of Mauritius in order to ascertain definitely whether the culture of the gourami is carried on there with conspicuous success. This was done, and a reply duly arrived, forwarding papers relating to this matter, and adding "that if it is desired to introduce the gourami in Ceylon, this Government will be glad to arrange for a supply of young fish being sent," The gourami, it appears, is not made the object of methodical cultivation in Mauritius, but, when desired, it is transplanted from one place to another. A gentleman who has interested himself in acclimatisation experiments in Mauritius, Mr A Daruty de Grandpré, states that the rearing of the gourami is very easy, as it will exist in any kind of fresh water, flowing or stagnant; its habits are herbivorous and insectivorous, and it is therefore valuable as a consumer of mosquito-larvæ; it constructs a nest amongst aquatic herbs, where it deposits its eggs, which are defended by the male. [Interesting extracts are quoted, through the obliging kindness of the Government of Mauritius, to show the value of the gourami, and the comparative ease with which it might be introduced in Ceylon.] Its distribution after its arrival would be a matter requiring careful consideration. The liberation and re-capture of introduced fishes without any record being kept would probably be an unsatisfactory proceeding.—ARTHUR WILLEY.—March 31, 1909.—*Administration Report on Marine Biology.*

UTILISATION OF PARA RUBBER SEED.

Experiment with Seed sent from Ceylon.

Attention has been directed already in this *Bulletin* (1903, 1. 156, and 1904, 2. 22) to Para rubber seed as a source of

A DRYING OIL.

The seed has a thin shell which forms about 58 per cent. of the whole. This contains a small amount of oil which for practical purposes may be neglected. The kernels contain about 42 per cent. of oil, which when exposed to the air "dries" in the course of a few days, yielding a clear transparent film. It generally resembles linseed oil in properties, and like the latter could probably be used in the manufacture of paints and varnishes, rubber substitutes, oil cloth, soft soaps, and similar products. A small consignment of the *kernels* (decorticated seed) was received recently in this country from Ceylon, and the oil expressed therefrom has been sold at the rate of 21 shillings per cwt. to a manufacturing firm in this country for trial on a small commercial scale. Analyses of the "cake" left after the extraction of the oil, were made at the Imperial Institute in 1903, and these showed that it had about the same "nutrient value" as linseed cake. Up to the present practically all the supplies of para rubber seed available have been used for planting purposes, and consequently feeding trials with press cake prepared from the kernels have not been carried out, but such experiments will need to be undertaken before the cake can be marketed as a feeding-stuff. Owing to the great extension of para rubber planting in Ceylon, Malaya, and elsewhere in recent years, large supplies of this seed will be obtainable as a by-product in the near future, and these can probably be put to remunerative use as a source of drying oil and feeding cake. It is probable that it will prove more remunerative to export the seeds or the kernels (*i.e.* the shelled seeds) to this country than to express the oil locally, since it will probably be easier to find a market for the press-cake in Europe than in the countries in which the seed is produced. Further, the cost of packages for the transport of the oil would doubtless prove to be high in the tropics. Before exporting kernels great care should be taken to see that they are thoroughly dry, so as to avoid deterioration during transit. The Imperial Institute will be glad to receive any further information or inquiries relating to the utilisation of these seeds.—*Bulletin of the Imperial Institute.*

PAPER FROM COCONUT HUSKS.

"Chambers's Journal" for April gives a brief account of the interesting experiments being conducted by Messrs. J Brown & Co., Penicuik, paper manufacturers, with coconut husks for the manufacture of paper. The outer rind of this husk is of a very liquified character. Inside this rind is a pithy structure about two inches in thickness, interlaced throughout with very strong, long fibres of a jute-like, inquified appearance. In the boiling treatment of the husks, two large samples of the selected material were dried at a temperature of one hundred degrees centigrade, and then accurately weighed. The outer rind of the one was then pulverised and the other left in its original condition. Each sample was then placed in a separate bag made of Hessian cloth, and boiled for four hours at a pressure of thirty pounds per square inch, with 18 lb. of sodium oxide per cwt. in esparto boilers alone with the esparto grass. The boiling operation completed, the husks were examined, and it was then ascertained that this treatment was not sufficiently drastic to destroy the pithy constituent in the rind, while the latter was scarcely affected or softened by the boiling. These results proved that to separate the cellulose from the non-cellulose portions of coconut husks much higher temperatures and pressures would be required. The sample of coconut husk in which the rind was broken up was resolved to a greater extent than that left untouched. Further experiments were, therefore, carried out with the former bulk. It was treated with thirty-six pounds of bleaching powder per hundredweight; but even with this excessive proportion of bleaching agent (which is about four times that required to impart a pure white colour to esparto) the husk was but slightly whitened, another proof that the boiling process was not sufficiently prolonged or severe. To prepare a suitable paper-making material from such a waste as coconut husk is obviously very difficult, if not impossible, but laboratory experiments are to be continued with a view to give the material a further chance.

THE CULTIVATION OF PASSIFLORA FŒTIDA AND MIKANIA SCANDENS.

To Keep Down Other Weeds.

The Agricultural Bulletin of the Straits and F.M.S. for June, 1909, reproduces from the Supplement to the "Tropical Agriculturist," the article on the above written by Mr. M. Kelway Bamber. The Editor adds the following:—

Note.—We reprint this excellent article from the Supplement to the "Tropical Agriculturist," April, 1909, p. 393, as it will be of interest to planters. I fear the F.M.S. planters cannot claim as original the employment of the *Passiflora* as a Lalang strangler. It was utilised very many years ago by the Dutch and seeds were sent to German New Guinea for this purpose about 1898, from the Botanic Gardens, Singapore. Its adoption as a weed killer here came much later. The plant is a native of Brazil, but seems to have been introduced probably as an ornamental plant to England in 1731, thence to the East Indies. It is now common all over the East.

One of its advantages as a weed killer is that it does not climb up the trees as so many other climbing plants such as the Ribu-Ribu fern *Lygodium* does. *Mikania scandens*, not an uncommon plant here, is not, (here at least) so strong a grower. It is a stouter plant, and I should say does not possess so many advantages as the Passion flower.

Some of the common Convolvuluses might be used. I have seen one in particular growing over Lalang and scrub along the line between Klang and Kwala Lumpur, which seems to do its work of strangling the grass and weeds well. It is *Ipomea sepearia.*

THE NEW SYSTEM OF TAPPING.

Notwithstanding recent adverse criticism, Mr. Northway's faith in his tapping system, our representative learned in conversation with him, remains absolutely unshaken ; and he has every confidence that it will yet justify his belief in it on any estate where it is properly carried out and given a fair chance. Discussing the question of the "rubber pads," Mr. Northway explained that before tapping a tree, in order to get a good result, it is

NECESSARY TO CLEAN THE TREE,

by scraping off the dry bark. The effect of allowing the light and heat on to the green bark is to attract the latex there. If the tree is not tapped soon after the dry bark is scraped off, the latex stagnates there and pads are formed. Many people who tried the system cleaned their trees days ahead of tapping. Mr Northway does not fear that the action of the pricker will prove destructive to the tree. The pricker goes into the cambium, he stated, but the cambium heals very rapidly. The wound begins to heal almost immediately on the cessation of the flow of latex. What he did consider bad was

PRICKING WITH A BLUNT PRICKER

which, instead of distinct pricks, gave a kind of ragged cut all round. Distinct pricks were essential to success. A consignment of

2,000 PRICKERS SPECIALLY SUITABLE FOR THE SYSTEM,

and on which the depth of the teeth can be regulated, is expected in Ceylon shortly. Mr Northway is quite satisfied that he can get infinitely better returns from his trees by this system than by any other. He has many explanations to offer which would account for the failure of other planters to secure equally good results by the adoption of the system ; and he hopes that some time in the near future his own business may be so arranged as to permit of his occasionally visiting other rubber estates and personally instructing brother planters in how to successfully apply the system.

Personally we must admit that the reports which have been reaching us have not been very favourable; but we hear of

ONE ESTATE IN THE KELANI VALLEY WHICH IS DOING EXTREMELY WELL WITH THE SYSTEM.

It may be that Mr Northway is right and now that the first wild rush into the system has been checked by the unsatisfactory results obtained those who take it up calmly and carefully will get the results and reap the benefits of it.

Mr H B Kirk, of Periyar Rubber Estate, Muvattupuzha, S. India, writes as follows to the Local "Times":—

"The fallacy of the figures given by the witnesses to Mr Northway's demonstration on December 19th, 1908, was that they omitted to mention that December is the best yielding month in the year, and, having observed Mr Northway's *best cooly* extract 4 lb. 14 oz. of dry rubber from one acre of rubber on a most favourable yielding day, they then multiplied it by 36 days and gave the result. If you apply this method to tea and turn on your best plucker to a given area during your best crop months, and then multiply it by 300 plucking days, you will establish a record new plucking system. Mr Northway's check-roll figures in May show us

WHY SO MANY SUBSCRIBERS ARE DISAPPOINTED

in their results. Here he has six of his best tappers working for 23 days and averaging 1 lb. 1 oz. per diem, presumably obtained from 100 trees which, taking 200 trees to the acre, gives you 80½ lb. dry rubber, including scrap, against 176⅜ lb. on December 19th, 1908. Mr Northway, in December, considered 36 days tapping ample for the year, but he now advocates 60 days, which, on May results, will give him a yield of 131 lb. an acre. Mr Northway, in reply to Mr Carson, said:—"The trees are not at their best. It is too soon after wintering." Quite so! His happy selection of December to demonstrate it shows us this. Had he demonstrated on May 7th, 1909, his yield per acre for 36 days would have been 55 lb., and for 60 days 78 lb., or about 3·8th of a lb per tree. But I find May is a fair "average" month, and I attach, for your perusal only, my yield per tree for each month of the year, which seems to show that, in July, August, September, October, February, March, or April, Mr Northway will get less yield per tree than in May. To obtain a yield of 1 lb per tree on the Northway system, we will have to tap about 95 average days in a year. Or, if the trees will stand it, tap them from December 1st until January 15th, the whole acreage with 2 coolies an acre, sail for home with your crop, and return in November. Only you must increase your factory accommodation slightly.

Seriously, will Mr Northway oblige us with figures showing his yield per acre, or per tree, for each month of the year?—and many disappointed subscribers will take heart and try again in December who now sleep ill of nights, writhing under Mr Wiggin's stigma. And I would suggest our being informed as to the average cost of tapping per lb. in each month. Sadris Appu brings in 1½ lb. of dry rubber a day in May, while Theneris can manage but 1 lb, and Punchi Nona is not quoted. I would be obliged if you could inform me what the maximum and minimum temperatures were on December 19th, 1908, compared with other December days.

LANADRON CO. EXPERT'S VIEWS ON RUBBER.

June 17th.

DEAR SIR,—In the *Ceylon Observer* of the 14th you publish a very full report of the Lanadron Rubber Estates Co. I had the pleasure of being a fellow-voyager of the Chairman of this Co (Mr. Andrew McIlwraith) to Ceylon from Marseilles last November, and he favoured me with the opinion the Consulting Chemists of the Company, Messrs. Clayton Beadle and Stevens of London, had formed regarding rubber from their estates as follows:—

a. The quality of the rubber is not affected by the age of the tree which yields the latex.

b. Vacuum drying, as at present carried on in the estates, lowers the quality of the rubber; but this may be modified by curtailing or lengthening the time it is in the vacuum press.

c. The quality is the same from natural or renewed bark.

d. The use of formalin in the latex does not affect the quality of the rubber.

e. The quality of the rubber obtained, when acetic acid is used, appears to be at least equal to that obtained by natural or spontaneous coagulation.

They also added: We are as yet unable to come to any decision in the keeping qualities of vulcanised rubber.—Yours truly,

W. D. G.

CACAO BEETLE.

A useful little pamphlet on the "Insect Pests of Cacao" has just been published by the Imperial Department of Agriculture for the West Indies, in which the following methods are recommended for dealing with the cacao beetle:—"When it is known that the grub is in the tree, it may be dug out or the tunnel probed with a stout wire. The presence of this grub may be detected by the chips and excrement thrown out at the mouth of the burrow. The bark over the infested area shows a dried and shrunken appearance, and by removing a portion of such bark the burrow may be found. Any wounds made in the tree in digging out the beetle grubs should be promptly tarred over, or treated with a mixture of rosin oil and tar, to prevent the entrance of fungi. It will probably be best to remove all dried bark, and thoroughly clean the wood, wherever these injured places are found. If the wood thus cleaned is properly tarred over or painted with rosin oil mixture, the bark will grow over the wound satisfactorily. The adult beetles are active by night, and may be found resting on the trunks and larger branches of the cacao tree in the early morning. At this time they may be collected, and if thrown into the water, to which a small amount of kerosene has been added, they will be quickly killed. In Surinam, it is the common practice to tie large pieces of bark of the silk cotton tree to the trunks of the cacao, to furnish a hiding-place for the beetles. They may be collected from these places during the day. It would seem likely that strips of burlap (bagging) tied round the cacao trunks would, as in the case of silk cotton bark, furnish convenient places for collecting these beetles. In Grenada, the cacao beetle is trapped by leaving the branches which are cut from the trees on the ground for about three weeks. All wounds on the trees which might attract the egg-laying beetle are tarred carefully. The adult beetles will visit the dead branches on the ground and deposit their eggs. These branches are then collected and burned. It is necessary that the branches be thoroughly destroyed. If they are neglected or left too long, they become breeding-places for increasing the numbers of the beetles."—GRENADA.—*Journal of the Royal Society of Arts*, May 28.

LIMA AND OTHER BEANS.

Colombo, June 24th.

DEAR SIR,—In the March number of the "Tropical Agriculturist and Magazine of the Ceylon Agricultural Society," there is a letter from the Hon. Mr. J. P. Lewis on this subject, together with a list of the vernacular names of beans commonly found in the Kandy market.

As these names are apt to vary it is not safe to rely upon them for purposes of identification, and this is proved by the errors that have crept into Morris' list of pulses on page 71 of his catalogue of Ceylon plants, as well as in Trimen's Hortus Zeylanicus. To give one instance, mè-karal, the common long bean (*Vigna sinensis*) is given in both lists as *Phaseolus lunatus*, the Lima or Duffin or Rangoon bean.

In Mr. Lewis' list awara-damala, as far as I can make out, is a variety of *Canavalia ensiformis*, the sword or sabre beans. Daluk-damala is the Princess or 4-winged bean (called in Australia the Asparagus pea) and known botanically as *Psophocarpus tetragonolobus*. Machchu (or Mutchch) kotte is *Dolichos Lablab*—a favourite with Indian Tamils. The other three dambalas mentioned (El, Kos-eta and Ratu) are, I take it, varieties of *Phaseolus lunatus*. regarding which Church, in his "Food Grains of India," says that the seeds are variable in colour, marking and size. He also mentions that the large white seeded kinds, with at most a brown or black mark close to the hilum (the place of attachment to the pod) are to be preferred to those with flattened and rather reniform seeds with blotches of red or veinings of black.

I am getting for distribution a supply of the best eating varieties of the lima bean, which, as Mr. Lewis remarks, is much to be preferred to the French, Kidney or Haricot bean.

The 4-winged bean deserves to be cultivated more extensively than it is at present. It is sometimes grown for its "yam." The guar or cluster bean (*Cyamopsis psoralioides*), introduced from India, is getting to be commonly known locally through school gardens as "Kotaranga." Like the soy bean the pods are somewhat hairy. Many varieties of American "Cow peas," which are hardy and prolific, are worth cultivating for the sake of the pods and are, indeed, being grown for that purpose about Colombo, having spread from the Government Stock Garden.—Yours truly,

C. DRIEBERG,

Secretary, Ceylon Agricultural Society.

COCONUT STEM DISEASE AND CROPS.

Kandawala, Negombo, June 17th.

DEAR SIR,—I had expected some valuable contribution to accurate knowledge from so experienced a planter as "B" of Marawila instead of bare contradictions and ill-disguised sneers, and further such an old and frequent contributor to your journal as "B" should have taken a little more trouble to ascertain what I had stated in

the paper of mine he refers to before flatly contradicting my statements. I give in parallel columns both my statements and "B's" contradictions and leave your readers to decide wherein we differ, adding only that in my paper I gave reasons for my statements. I shall be glad if others as well as "B" will undertake the simple "surgical operations and investigations" "B" scoffingly refers to in this and a previous contribution and report results. I was in hopes that many would have done so in the interests of accurate knowledge:—

"B"	J. D. V.'s paper:—
Mr. J. D. Vanderstraaten not long ago read a paper in which he said that the crops of *three* years are *inside* the stem of the tree. I must, however, state that my invariable experience has not been in accord with the conclusions drawn by Mr. J. D. V. as the result of his surgical investigation. Without exception, I have always found improvement in the appearance of the trees and in blossoms, 12 to 18 months after the application of manure. The resulting crops are gathered twelve months after that.	"In manuring we find an increase in the crops during the 1st year, simply because the blossoms for the 1st year's crops were all out and set and in various stages of development already when the manuring took place—perhaps after a few months we find less of the tender young coconuts falling, owing to the increased nourishment afforded by the manure; so also we notice a slight improvement in the kernel from the same cause. During the 2nd and 3rd years there is a marked and gradual increase of crop, still due

to the *improved* vigour of the trees and consequent fertilising properties of the pollen which otherwise would have been largely infertile. The increase of crop during the 3rd year may be quite double the previous yield or even more, but it is after the 3rd year that the full effect of manuring are felt by the trees, the increase in nuts of previously unmanured gardens being quite four to five fold... Counting all the flowers from the one just opened to the smallest spathe in the heart or cabbage that could be examined by a magnifying glass, I found there were 34 flower spathes in the tree I examined and the smallest spathe had clearly distinguishable female flowers. Now taking 16 as the average number of branches put forth on a healthy tree we get *two years and say two or three* months for the last distinguishable spathe to arrive at the crown of the tree and burst into blossom—to this must be added another 10 or 12 months before we can gather the fully matured nuts from that branch.

The question of how long it would take for the bleeding disease to kill a tree or to affect the crops is quite distinct from that of the time from first formation of the flower buds to the maturing of the fruit in ordinary cases. Whatever affects the vitality and nutrition of the tree must necessarily affect it throughout—to what degree and within what time depending entirely on the extent of the interference.

J. D. VANDERSTRAATEN.

June 19th.

DEAR SIR,—Before I reply to my friend, "J. D. V."'s letter, I must bow my acknowledgments to him for his complimentary reference to my experience, though it is more than counteracted by his expression of disappointment at my not answering his expectations of "accurate knowledge," &c., &c. It is very evident that what moved "J. D. V." to write and to indulge in comparisons through the means of parallel columns, was his discovery of "ill-disguised sneers," where such were not intended.

In his lecture before the Agricultural Society, Mr. Vanderstraaten stated that he dissected the heart or cabbage of a coconut tree. I playfully referred to that as a "surgical operation" and in another instance as a "surgical investigation." Was my interpretation of the word wrong? No, not by any means, unless my motives are "dissected," and false conclusions drawn from them.

I must, however, apologise to Mr. Vanderstraaten for not studying his lecture with the attention that so valuable a contribution to coconut cultivation deserved. I glanced over it and discovered, immediately after his long quotations in parallel columns: "this gives us the period of *three years* at least, and I suppose a few months must be allowed from the beginning of the manuring period, for the initial formation of the flower spathe in embryo." I got the idea of "three years" from the hasty perusal of the paper. I see I must deduct nine months from that period. I have not the inclination, qualification or time, to criticise Mr Vanderstraaten's or any other lecture. I made a few remarks on it casually, and have very unfortunately trodden on his ultra-sensitive corns.

It might be news to Mr Vanderstraaten to be told that I too dissected the womb of a coconut tree, called in Sinhalese parlance "polbada," and discovered immature flower-spathes with "kurumbetties," or immature nuts formed on them. But I must confess that the operation was not performed to gain "accurate knowledge," but to satisfy idle curiosity. I did not use a magnifying glass, nor did I count the flower-spathes. The more shame to me.

During a business visit to the estate from where I write, I imparted the information had gained by my idle curiosity to Mr Kelway Bamber and presented him with a "polbada." It is to be hoped that he has investigated the subject scientifically.—Truly yours,

B.

1908-9 EXPORTS OF CHINA TEA.

Sussex, June 3rd.

SIR,—The difficulty experienced at home and abroad of obtaining accurate information respecting the China tea trade has been forcibly illustrated by the difference noticeable during the past season between the statistics issued in Hongkong—which have been quoted in Colombo and copied in London—and a computation made from information derived direct from other sources in China. For example, it was reckoned here months ago that the total exports were rather heavier than in 1907-8, whereas at the beginning of April the figures printed in Ceylon stated that they were 24,000,000 lb. lighter, while at the end of the month an increase of 26,000,000 lb. was mentioned. [The latter error was afterwards corrected.—ED., *C.O.*] In these tabular statements the entries relating to Russian and American shipments are not reconcilable with the advices received in England from China. The final statistics have not yet been published, and the figures at the foot are subject to correction, but they are based upon the best information obtainable here, and will probably prove to be nearly exact.

It is, of course, recognised that the volume of business done in China tea has not now the same influence upon the market for Ceylon or for Indian tea as it had in times past; but it is

desirable to know with some approach to certitude what is being taken from China by the foreign countries to which we are looking hopefully for expansion in the business we do with them, and in the light of that knowledge to re-adjust estimates which perchance have been made from imperfect *data*. Those who are convinced of the superior merit of British-grown tea naturally believe that it will eventually supersede its rivals in most of the world's markets; but that cannot be until two things have happened, the first being a total supply of it large enough for the purpose, and the second a complete change in the taste of those who prefer to use kinds of tea which we either cannot or do not produce. Neither of these conditions is within sight. In the meantime, foreign buyers, who have no preferential interest in our industries, have made larger purchases in China, aided, no doubt, by a favourable rate of exchange; and it is well to know it.

APPROXIMATE TOTAL EXPORT OF CHINA TEA (not including Brick.)

	Season 1907-8. lb.	Season 1908-9. lb.
To the U.K.	22 500,000	15,000,000
„ Continent	12,250,000	16,500,000
„ Russia	41,500,000	48,500,000
„ America	42,500,000	51,000,000
„ Other places	4,250,000	4,000,000
Total.	123,000,000	135,000,000

Formosan tea, although now passed through Japanese hands, is by custom reckoned as Chinese and is included in the above figures.

Of the total increase of 12,000,000 lb. about 5,000,000 lb. are black and about 7,000,000 lb. are green tea. The increased entry for the Continent is about equally composed of black and green, the probable destination of the latter being for North African markets.

Russia has taken rather less black, but much more green tea, which is said to be for sale in the Central Asian provinces where green tea is in demand, and the means of buying it provided by a bountiful harvest.

America has taken less green tea, but a much larger quantity of black, far in excess of any known rate of consumption, coincidently with the heavy purchases made in London for the United States under the belief that an import tax would be imposed.

AN ENGLISH SUBSCRIBER.

THE LORANTHUS PEST.

An article in "Ceylon Men" by Mr C Drieberg, B.A., F.H.A.S., is of timely interest. He says: Considerable attention has lately been drawn to the plant known by this name (called in Sinhalese *Pilila* and in Tamil *Kuruvichchai*), owing to an alarming report that it is threatening the destruction of the tea plant in the neighbourhood of Nuwara Eliya.

The genus Loranthus, to which the English mistletoe is closely related, includes some seventeen species, five of which are found in the moist low country, two in the dry region, and four at high altitudes; the rest are more or less general in their distribution. No less than eight species are endemic, that is peculiar to the Island.

The flowers are tubular and variable in colour being green, yellow, pink, purple, scarlet, orange or brown, or of mixed hues. Loranthus does not grow on the ground like any ordinary plant; but attaches itself to another plant. Hence it is called a parasite, and the plant upon which it grows the host. Parasites may be divided into two classes:—

(1) Complete or true parasites, which depend entirely on a host for their nutrition, neither procuring nor preparing food on their own account.

(2) Partial parasites, which look to the host to supply them with only part of their crude food, procuring the rest for themselves. They are able to prepare their own food.

To the former class belong the parasitic fungi which cause serious diseases in plants, such as the coffee leaf disease which ruined the industry in Ceylon. Loranthus belongs to the latter class.

To more clearly understand the difference between these two classes it is necessary to know something about the nutrition of plants. Ordinary plants get part of their food, by means of their roots, from the soil; and a part, by means of their leaves, from the atmosphere. Now the presence of green colouring matter in the leaves is necessary for getting food from the air. As the complete parasite has no need for doing this, it is destitute of green colour, but a partial parasite, like Loranthus, is coloured green, which indicates that while it gets its soil-food from its host, it procures its atmospheric-food direct, and also elaborates or prepares its food, that is, transforms the raw materials, consisting of solutions of inorganic matter, into organic substances.

Though it would appear that Loranthus does not cause such serious loss to the host as do the true parasites, yet the damage it does is considerable, and if not interfered with it generally kills its host in the end.

In the low-country Loranthus is commonly seen on old mango trees; in the Nuwara Eliya district it infests the Australian acacias (wattles) found growing about the town.

The eradication of a partial parasite, like Loranthus, is a very much easier matter than the eradication of a complete parasite. Loranthus is propagated by birds conveying the seeds to the branches of trees, to which the parasite attaches itself by sending its roots into the wood tissue of the host from which it sucks the crude sap brought up from the soil. Parasitic fungi on the other hand are propagated by spores, which are microscopic bodies, corresponding to seeds in the higher plants, and easily conveyed by wind and other agencies. When it is further stated that the parasitic fungi are extremely minute organisms and mostly live in the internal tissues of the host, it will be understood how difficult it is to deal with them. In order to protect trees from Loranthus it is only necessary to watch for and cut out the parasite as soon as it appears; but it must be removed completely, "root and branch," or it will start growing again. In this way we can soon get rid of Loranthus, but there is always the danger of its again finding its way into our gardens if our neighbours harbour the pest. Landowners and householders should therefore co-operate with one another in order to keep out this enemy of our cultivated plants.—"Ceylon Men," June, 1909.

CITRONELLA OIL.

As was to be foreseen, the prices of this article have moved in very narrow limits; nominally they remain below 1/- cif. even at the present time, although exporters in Ceylon until quite recently stood out for somewhat higher rates.

The exports from Ceylon amounted to	...	1,276,965 lb.	in	1908
against	...	1,230,159 ,,	,,	1907
,,	...	1,107,655 ,,	,,	1906
,,	...	1,282,471 ,,	,,	1905

The exports from 1st

Jan. to 15th Feb.	1909	amounted to	126,038 lbs.
do.	1908	,,	76,291 ,,
do.	1907	,,	47,041 ,,
do.	1906	,,	116,017 ,,

The above figures show that the excess of exports in the first five or six weeks of the new year is already about 50,000 lb. as compared with the year before, from which it may be concluded that the reports as to scarcity of supplies which periodically reach us from Ceylon are not to be taken very seriously.

At the present time it is difficult to judge what course prices will take within the near future. Although on the one hand the increased exports may give rise to the belief that the consumption of this oil is again on the increase, we have on the other hand to take account of the fact that, because of the

SEVERE COMPETITION

which exists among them, large soap manufacturers, especially in England, no longer consume anything like as large a quantity of citronella oil as in former years. Almost everywhere, slightly scented household soap is being superseded by strongly perfumed cheap toilet soaps—a result of the extremely low-priced synthetic perfumes which in recent times have found more and more favour with the public. In these circumstances, we believe that it may be assumed with some certainty that the

PRESENT PRICES WILL NOT SHOW ANY SERIOUS FLUCTUATION

for some months to come. There is absolutely no ground for expecting an advance in prices.

The sale of the highly popular

JAVA CITRONELLA

oil within the past few months has also been extremely sluggish, and indications are already perceptible of over-production, on the ground of which a prospective decline in prices of this variety is also to be looked for.

As in the case of lemongrass*, de Jong† has also conducted experiments on the oil content of the various parts of Java citronella grass (*Andropogon Nardus* Java ; *sereh wangi*) in different stages of development, in order to discover which is the most favourable time for distilling. The result was exactly the same as in the case of lemongrass ; as the leaf ages, the oil content decreases; the sheaths of the leaves and the roots contain much less oil than the leaves themselves. In this case also, de Jong considers it the best plan to cut the grass as soon as four or five leaves have developed. The greater richness in oil of citronella grass as compared with lemongrass was remarkable; the former usually yielded three or four times much oil as did the latter. As regards the properties of oil from different batches of old leaves, the optical rotation and total geraniol content (= geraniol + citronellal) show only insignificant variations. The rotation varies irregularly; values ranging from—27°′ to—7° 36′ being observed in oil from leaves of various ages. The total geraniol content first increases in an ascending scale from the newest up to the oldest leaf and afterwards decreases in a corresponding manner; the lowest value was 85·5%, the highest 93·3%. The results of this investigation induced de Jong to make experiments as to the time required for acetylation, the behaviour of the oil towards acetic anhydride, the volume of acetate of sodium to be added, and the time required for saponification. On the basis of these enquiries de Jong considers that two hours are needed both for acetylation and for saponification, and that for every 20 cc. of oil and acetic anhydride, 2g. of sodium acetate are required in order to produce accurate results. He concludes this because in his experiments on citronella oils, he obtained the best values by following this method.

The oils examined by de Jong were soluble in their parts of 80 per cent. alcohol; when more than four parts of the solvent were used, turbidity ensued. According to our observations, the Java oils of commerce make a clear solution with 1 to 2 vols. of 80 per cent. alcohol and more. Only in exceptional cases does the diluted solution show opalescence.

In our last April report‡ we called attention to the occurrence of dextrorotatory citronella oils, a phenomenon which had never previously been observed. An oil of this kind is also referred to in the Buitenzorg Annual Report for 1907§. It had an optical rotation of + 0° 45′ and a specific gravity of 0,87.

CITRONELLA IN GERMAN PACIFIC ISLES.

The experimental cultivation of citronella grass in the German Pacific Islands having been crowned with success, and resulted in the production of oils of good quality, closely approximating Java oil, we now gather from a paper read in Berlin by Prof. Preuss‖ that *Andropogon Nardus* (author?) is to be more extensively cultivated, as its distillation has already been taken up on a large scale. From a specimen sent for our examination we have been able to satisfy ourselves of the good quality of the sample distillates. The specimen examined has the following characteristics; $d_{15°}$ 0,8819, a_D — 0° 46′, $n_{D20°}$ 1,46278 ; joint, content of geraniol and citronella 85,9 o/o, soluble in 1,3 vols. and more of 80 per cent alcohol.—*Schimmel & Co.'s Semi-Annual Report* for April, 1909.

* See Report November 1908, 81.

† Teysmannia, 1908. From a copy kindly sent to us.

‡ Report April 1908, 32.

§ Jaarboek van het Departement van Landbouw in Nederlandsch-Indië 1907, 67. Batavia 1908.

‖ Berichte d. deutsch. pharm. Ges. (1909), 25.

CAMPHOR OIL IN 1908.

There has been very little change in the tendency of the camphor oil market during the course of the past five months. The dull state of business, as well as the fact that the existence of important supplies tied the hands of those interested, caused a further reduction in the quotations, and even at the present moment holders in Japan are inclined to accept reduced offers. The shipments from Japan were quite insignificant, except as regards a few thousand cases which were exported to the United States. Within the past few weeks camphor has shown

A SOMEWHAT MORE ANIMATED TENDENCY,

probably accounted for by the fact that, since prices have reached a lower level than has been known for a very long time, the competition of artificial camphor may be regarded as entirely removed. For the present we regard it as very little probable that this firmer tendency will also influence the camphor oil market, especially in view of the enormous quantities which must have accumulated in Japan. With regard to

CAMPHOR PLANTATIONS IN CEYLON,

the American Vice-Consul W C Doyle *a* reports that in 1907 the area under cultivation was increased from 142 to 1,106 acres, and that for 1908 apparently a still greater increase was projected. As a result of these extensions a perceptible contribution to the World's requirements in camphor was to be expected. The camphor tree does not flourish in the coast region, but it does well in the mountainous districts of the Island, at altitudes between 2,500 and 8,000 feet. The yield of camphor from a cultivated area of 15,000 to 20,000 acres is estimated at 8,000,000 lb. which (according to most authorities) is the quantity needed to supply the world's requirements, and hopes are entertained in Ceylon that, within the course of a few years, more camphor will be produced in the Island than is consumed on the entire globe at the present time. Among planters, the rapid growth of the branches of the camphor trees is regarded as the cause of the pre-eminence of Ceylon over other camphor-producing countries. The cost of producing natural camphor in Ceylon is estimated to be considerably lower, weight for weight, than the cost of the American synthetic product from oil of turpentine. The first experiments of cultivation in Ceylon were made by the Government with Japanese camphor seed, and the mode of cultivation consists in allowing the tree to reach a height of 40 ft. (which it does in about 3½ years), when it is cut down to 4 or 5 ft. With this object in view the trees are pruned every 4 aud sometimes every 3 months. The trees are planted at distances of 4 by 8 ft., which gives 1,360 trees to the acre. Experiments of distillation made with the wood cut from an acre of ground, produced 190 lb. of camphor. One planter maintains that he has obtained a particularly

HIGH YIELD OF CAMPHOR BY PRESSING THE BRANCHES

instead of distilling them. But although he vouched for the truth of this statement, he refused to disclose any particulars as to the process.

The Official Customs Statistics indicate that in 1907 a parcel of camphor weighing 562 lb. was exported from Ceylon, and it is inferred from this that the quantities to be exported annually in the future will increase in geometrical proportion.

An American expert, Prof. Hilgard *b*, has written on the subject of the question of the

CULTIVATION OF CAMPHOR TREES IN THE UNITED STATES,

his paper being a sequel to that of Rivière which was discussed by us at the time *c* and which takes the same view. Prof. Hilgard has made enquiries from the experts in the Agricultural Department at Washington and in the Southern States of the U. S., as to the prospects of camphor cultivation. The first-named authorities informed him that although the Government had made experiments in the growing of camphor trees in its Southern Experimental Stations, it doubted greatly the financial success of such an undertaking, and for this reason: it does not supply camphor seed to any private people, who are able to obtain their requirements of such seed from the trees which had already previously been planted in Florida and California. In most of the plantations the trees are regarded only as ornamental, and are treated as such, but in some of them experiments have been made to obtain camphor by distilling the leaves, either with or without stalks. The results of these experiments are not reported by the author, who only deals with his own experiments in making industrial use of the Californian camphor tree. According to these experiments, mature green leaves yield about 1 per cent by weight of camphor, and it is to be noted that leaves and green twigs contain more liquid oil and less solid camphor. Up to the present no higher yields of camphor have been obtained. Hilgard observes that he has experimented only with trees growing in the misty, cool climate of the coast, and not with trees from the warmer and higher altitudes, for instance those from the interior of California. Although the latter trees no doubt might promise a higher output, seeing that odoriferous plants such as jasmine, mignonette, and heliotrope also flourish in the interior of California, Hilgard refrained from making any far-going experiments, because of the excessively high wages (for the harvesting of the leaves), which in those districts are an obstacle in the way of the development of the camphor industry as well as of other industries. The author, therefore, agrees with Riviere that there is no question of any American industrial competition with the natural riches and low wages of the island of Formosa, particularly as just at the present time the prices for crude camphor are low and are likely to remain so.

With regard to the

PROSPECTS OF SYNTHETIC CAMPHOR,

Hilgard is of opinion that any serious competition with the natural product is out of the

a Oil, Paint and Drug Reporter 74 (1908), No. 23, page 52.

b Journ. d'Agriculture tropicale 8 (1908), 360. *c* Report November 1908, 36.

question until there has been a considerable increase in the present moderate yield, which equals only 25 per cent of the turpentine oil used. Moreover, account has to be taken of the quickly progressing exhaustion of the American turpentine forests. Hilgard conjures up a future vision of the preparation of camphor from petroleum, which is certainly a distant prospect and not a very credible one at the present time. At any rate, the experiments which have for their object the replacement of camphor by similar materials have much more chance of being realised.

In an appendix to the paper, Cayla lays stress upon the complete agreement of Hilgard with the views frequently expressed by him (Cayla), to which we have referred in previous Reports. Cayla regards Hilgard's statements as an indirect confirmation of the conclusions arrived at by Giglioli *d*, in so far as the latter particularly referred to the lowness of the wages in Italy and the age of the Italian camphor trees. Cayla is of the same opinion as Beille and Lemaire *e*, and also Giglioli, that the camphor production of the future will be established on the basis of

MAKING USE OF THE LEAVES,

a process which is already being applied in Formosa and Ceylon. Cayla also calls special attention to the impossibility of synthetic camphor becoming a serious competitor, in view of the present state of the prices; but in regard to this aspect of the matter he thinks that a change might be brought about if coniferous trees yielding turpentine or a similar oil were cultivated in suitable countries, especially in India and in Tonquin.

Cayla*f*, in his review of Giglioli's books *La canfora italiana* (to which work reference has also been made in our Report *g*, points out, in opposition to Rivière *h*, that according to the experience of Giglioli it is not necessary to remove the newly-grown leaves from the tree, thereby checking its growth. According to Giglioli, a satisfactory yield of camphor may be obtained from the leaves which have been shed by the tree and have been dried naturally by exposure to the atmosphere, the loss caused by the drying process not being considerable. Artificial desiccation on the other hand, may cause a loss of camphor-content up to 50 per cent. The suitability of dry leaves for distilling purposes is of interest, because this fact would appear to make it possible to press the leaves for transport to distilleries situated in suitable localities.

Watts and Tempany *i* have prepared essential oil from the wood, leaves and twigs of camphor trees grown in the botanical gardens in Dominica, with the following results:—

1. 90 lb. wood yielded 7,1 fl. oz. of oil; d27°-16,6° 0,9012, α_D—13,1°.
2. 33 lb. leaves and twigs yielded 2,75 fl. oz. of oil; d27°-16,6° 0,9024, α_D -18,4°
3. 29 lb. leaves and twigs yielded 6,2 fl. oz. of oil; d27°-16,6° 0,8987, α_D—19°

d Report November 1908, 36
e Report April 1908, 21; November 1908, 35.
f Journ. d'Agriculture tropicale (1909), 60.
g Report November, 1908, 28.
h Report November, 1908, 36.
i West Indian Bulletin 9 (1908), 275. From a copy kindly sent to us,

The low yield of oil in the second experiment is attributed by Watts and Tempany to the insufficiency of the condensing apparatus, which caused the loss of a considerable proportion of the oil. All the distillates were clear and colourless, and even during the cooling no camphor separated from them, which shows that that substance cannot be present in any considerable quantities. Watts and Tempny also state that in his annual Report for 1906*j*, Consul Playfair pointed out that the occasional absence of camphor from the oil was ascribed by many theorists to the circumstance that only those camphor trees which grow near the coast attain their full development*k*, while others declare that male and female camphor-trees grow isolated and that only the former contain camphor. Playfair considers the last-named theory to be incorrect, as the flowers of *Cinnamomum* are polygamous.—*Schimmel & Co.'s Semi-Annual Report* for April.

CEYLON CINNAMON OIL IN 1908.

We continue, as before, to devote special interest to the distillation of this important article, and we are able to state with satisfaction that owing to the exquisite quality of our product our sale has experienced a considerable increase. The prices of pure cinnamon oil remain unchanged, and the market for the raw material also has shown but slight fluctuations. The exports of Ceylon cinnamon chips were as follows:—

in	1908	2,785,824 lb.
,,	1907	2,835,936 ,,
,,	1906	2,531,614 ,,
,,	1905	2,325,514 ,,

Of this total, Hamburg imported:—

in	1908	about	554,400 lb.
,,	1907	,,	473,200 ,,
,,	1906	,,	386,400 ,,

Our own consumption in the past year reached about 115,000 kilos, that is to say, approximately about one-half of the total quantity imported via Hamburg.

It is remarkable that in 1908, 200,878 ounces of cinnamon oil distilled in Ceylon were exported, a figure reached never before, of which over one-half went to England. Compared with 1907, these figures indicate an increase in the exports of over 100 per cent. and the fact that, this notwithstanding, our distillate found a ready sale at full prices, should afford sufficient proof of its superiority.

In considering the export figures of Ceylon oil given above, it should be remembered that within the past year large quantities of cinnamon leaf oil were shipped from Ceylon, and that these are included in the above statistics. The manufacture of the last-named article has been carried on with an intensity that can only be characterised as senseless, no regard having been paid to the very limited consumption.

In an article in *Southall's Report* 1 the just desire is expressed that the Pharmacopœia requirements relating to Ceylon cinnamon oil

j Diplomatic and Consular Reports No. 3,913, Aug., 1907,
k Compare Report April 1908, 23.

should be extended so as to include a definite aldehyde content, in order to prevent adulteration by means of artificial cinnamic aldehyde. The cinnamic aldehyde content of normal oils has been ascertained to range between 70 to 71,4 per cent whereas adulterated oils have been found to contain from 77,6 to 86,4 per cent. The specific gravity of normal oils moves between 1,012 and 1,023, in adulteratod oils it ran from 1,027 up to 1,055.

The observations relating to the specific gravity of alleged authentic oils recorded in this article do not agree with our own findings, which are the result of records of very numerous observations with our own distillates. We have found the specific gravity of normal Ceylon cinnamon oils to vary from 1,023 to 1,040; lower specific gravities may porhaps be due to the use of defective raw material or to unreasonable methods of distillation. According to our experience, the aldehyde content of good Ceylon cinnamon oils ranges from 65 (to 76 per cent. —*Schimmel & Co.'s Report.*

NATURAL AND ARTIFICIAL CAMPHOR.

AN IMPORTANT LECTURE.

At the Congress of Applied Chemistry on Saturday Professor Haller, whose lecture on the chemistry of camphor preceded the above, said that the extended uso of camphor dated from the time when celluloid, of which it formed a constituent part, became the object of intensive and increasing manufacture. Tho important part it played in the industry of this plastic material, and the special qualities which it lent to the introcellulose with which it was incorporated, rendered it valuable for other purposes. It was used for the manufacture of pegamoid, a new substitute for leather, and entered into the composition of certain smokeless powders either as such or in the form of borneol. They were aware that camphor was prepared by distillation with steam from the wood of the camphor laurel, a fine tree which grew in Japan, in Formosa, where it still formed immense virgin forests more and more difficult of access, in various Japaneso islands, and also in several districts of Central China. Since 1899 Japan had secured the monopoly of the camphor crop throughout its territory and in Formosa. According to statistics published in a Japanese journal and reproduced by the *Chemist and Druggist*, the amount of camphor exported from Japan increased from 280,892 kilos, valuod at 200,452f., in 1868, to 1,834,594 kilos, valued at 13,069,831f., in 1907; and during the same timo the price increased from 69f. to 708f. per 100 kilos. In spite of an increasing production in China it appeared from the statistical evidence that the aggregate

OUTPUT OF CAMPHOR WAS NOT INCREASING,

and that they must rather expect to see it gradually diminish. And since the demand on the contrary went on increasing, it was easy to understand the high prices reached, which had driven the camphor industry to make up the deficiency in the production of the natural substance.

It was about 1905 that the first attempts to supplement tho supply by artificial camphor came into view. All the processes of manufacture started with pinene, a carbon compound found in the essential oil of turpentine. The latter was obtained by steam distillation from the resin yielded by various conifers growing in the forests of the temperature zone. The principal countries of origin were, in order of importance, the United States, France, Russia, the Central European States, Germany, and Austria. In recent years Spain had also contributed to the world's markets. The French essence produced from the sea pine was considered to hold the first place in respect of quality; that of the United States, from pitch pine, was less valued; and those of Russia and Germany, obtained chiefly from the *Pinus silvestris*, were of inferior quality. The question of industrial camphor depended as much on the price of a good essence as on the methods employed. The efforts expended on the problem had resulted in no new fact or original discovery. The numerous methods employed were only improvements or variants of reactions previously known. They might be divided into two large groups according to whether the essence was first converted into hydro-chlorate of pinene, or was submitted direct to the action of organic acids. The high prices of camphor, to which they owed the evolution of the new industry, had only been temporary for reasons which it was extromely difficult to discover. Only those establishments which in the fortunate period of high prices found themselves in possession of an economical and thoroughly efficient process and were in a position to organize a prompt supply in responso to the demand of the moment had been able to take advantage of the remunerative prices and recover the cost of installation. He should add that the camphor which they produced, apart from its optical inactivity, possessed in all respects the same properties as natural camphor when it was sufficiently refined. Comparisons had been made between the camphor industry and the alizarine and indigotine industries, and some enthusiastic spirits had not been afraid to celebrate this new triumph of industrial science. With regard to the two substances mentioned, science and industry had incontestably got the better of nature. The cultivation of madder had completely disappeared from the departments of the Midi in France and artificial indigo was on the way to ruin the immenso and numerous plantations of India, Java and Guatemala. Would the same thing happen with camphor? It would be rash to say so, for various reasons which he enumerated. The conditions were very different both with regard to the supply of natural product, the cultivation of which had been freshly stimulated, and with regard to the fundamental substance used in producing artificial camphor, namely, the essence of turpentine, the supply of which was limited and the price fluctuating. For these and other reasons the future of the camphor industry was uncertain.—London *Times*, May 31.